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Howard K. Gloyd, Director.

Committee on Publications:

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The Influence of the Balcones Escarpment on the Distribution of Amphibians and Reptiles in Texas

Hobart M. Smith and Helmut K. Buechner*

It is a common observation that the geographic ranges of many plants and animals are limited by the Balcones Escarpment in Texas, but little critical study has been made of the rôle of the escarpment as a natural boundary. The area offers much material for studies in speciation. The escarpment is in fact the eastern edge of the Edwards Plateau, an elevated area of features markedly different from those of adjacent territories. The plateau is xeric in nature, having less rainfall, scrubbier and more scant vegetation, a porous soil, little standing water, and an evaporation rate exceeding the precipitation rate. Surrounding lowlands are of mesic character, with more rainfall, lush vegetation, less porous soil, much standing water, and a rainfall rate exceeding the evaporation rate.

Various degrees and sorts of distributional limitation are exhibited by the numerous species occurring there, depending upon interaction of the wide variety of ecological conditions on the one hand, with on the other hand the physiological tolerances, life histories, habits, evolutionary history, etc., of the individual species. As the conditions are limited in occurrence, so are the animals limited; and as there are innumerable combinations of potentially limiting factors, so are there innumerable distributional patterns among the species concerned. The purpose of the present paper is to analyze the extent of limitation exercised by the factors correlated with the escarpment upon the geographical distribution of reptiles and amphibians in Texas.

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Most of the material for the discussion presented here was plotted in map form for all the amphibians and reptiles reported from Texas. These maps are based solely upon published reports, materials in the Texas Coöperative Wildlife Collection at the Agricultural and Mechanical College of Texas, and specimens in the private collection of Bryce C. Brown.

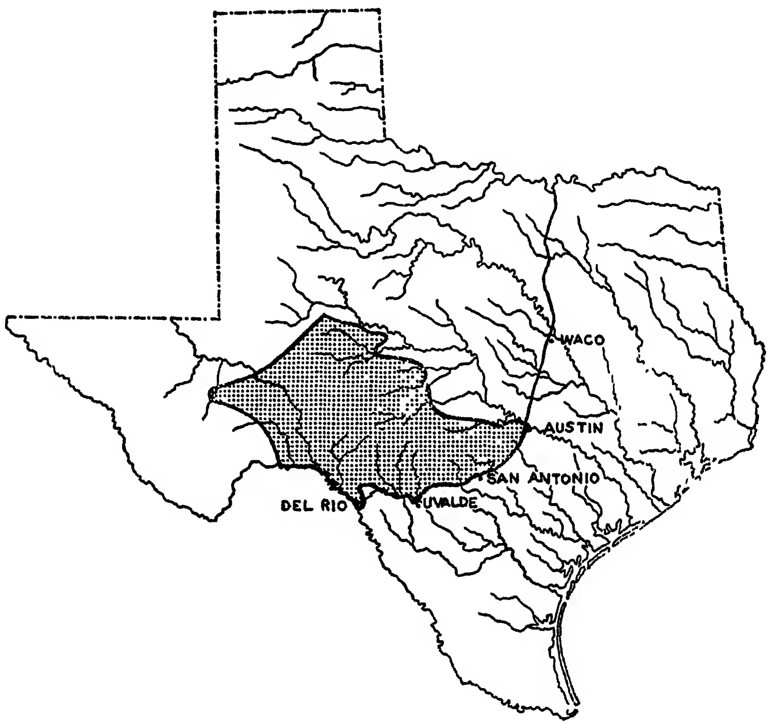

Figure 1. The Edwards Plateau of Texas, indicated by stippled area. The Balcones Escarpment forms its eastern and southern boundaries.

FEATURES OF THE ESCARPMENT AND ADJACENT AREAS

Location. The Balcones Escarpment forms an arc through central Texas, starting from Waco, extending southward through Austin to San Antonio, and then swinging west to Del Rio on the Rio Grande (see Fig. 1). It is not a single long vertical cliff, but rather a series of breaks in the earth's crust, forming cliffs, hills and plateaus up to a height of about 1000 feet. The highest parts are in the vicinity of Austin, San Antonio, and Uvalde; northward from Waco and westward from Uvalde the escarpment gradually decreases in height until it is recognizable only through the presence of small fault lines.

Climate. In passing through a distance of 10 to 20 miles across and at right angles to the escarpment in the vicinity of Austin, San Antonio, or Uvalde, one encounters conspicuous changes in the climate, vegetation, and animal life. In many places the change in vegetation is as sharply defined at the fault lines as a fence row between areas under different types of land use.

The Edwards Plateau, which lies northwest of the escarpment, has a much drier climate than the area to the east of the plateau. The average rainfall is about 25 to 30 inches on the plateau, about 10 to 15 inches less than the area east of the escarpment. The plateau temperatures are a few degrees cooler than the lower elevations. During every month of the year the evaporation on the plateau exceeds the amount of precipitation. This accounts for the dryness of the climate. Very little of the water which falls is available for plant growth, and permanent bodies of open water are seldom found. The fault area of the escarpment, however, is characterized by many clear, spring-fed streams. There are also several large caves with permanent water.

Vegetation. The xeric nature of the biota west of the escarpment is well expressed in the plateau vegetation (Buechner, 1944). An extensive carpet of oak and cedar covers most of the area, with eastern mesophytes (cypress, elm, hickory, ash, birch) finding a suitable habitat along the main streams. The oak-cedar woodland is more closely related to the vegetation of the lower slopes of the Rocky Mountains than to the blackland prairie and post oak-hickory forest to the east or the mesquite chaparral to the south (Tharp, 1939). There is a conspicuous difference not only in species of plants, but also in the growth form of the vegetation. As a result of the dry climate, the tree species are stunted, forming a midget woodland, which becomes a low mat at higher elevations on hill tops as well as farther west on the plateau.

Animal Life. The influence of the escarpment on animal life is as marked as the correlation between climate, soils, and vegetation. This is to be expected, since animal life, vegetation, and the physical environment all interact to produce the large entities known as ecosystems. Specific comparisons of the mammalian fauna and avifauna on either side of the escarpment have never been made. Nevertheless, in comparing the birds of Kerr County on the Edwards Plateau with those of Brazos County about 150 miles to the east (Buechner, 1946), it becomes obvious that the Balcones Escarpment has a definite limiting influence on birds. The birds of Kerr County have greater affinities to the more western bird life than to that of the east. The breeding birds there consist of more than twice as many western and southwestern forms as eastern. About 56 per cent of all the breeding birds in Kerr County find their range limits in the county, which is not far from the escarpment.

This figure compares fairly well with the 77 per cent of amphibians and reptiles that find their range limits at the escarpment.

A further study of other animals and of plants involved at the escarpment may lead to a definite percentage criterion useful in designating biotic areas. Indications from the present study are that the amount of permissible overlap at a natural boundary may be much higher than normally expected, even when a large number of plant and animal species are brought into consideration.

INFLUENCE OF THE ESCARPMENT ON AMPHIBIANS AND REPTILES

Since there is considerable variance in the effect of the escarpment on the various groups of amphibians and reptiles, our analysis is made by natural groupings. The species and subspecies were segregated, on the basis of their distribution, into several categories. We tabulated them, for each of the five groups (to wit, salamanders, anurans, lizards, snakes, turtles), as follows: (1) *limited* (that is to say, kinds which occur at the escarpment but do not cross it extensively in any direction) classified in turn as eastern, western, northern, southern or endemic (autochthonous species, defined as species originating in a certain area but now occurring to a limited extent in adjacent areas, were counted as endemic); (2) *overlapping* (kinds which occur extensively on both sides of the escarpment); or (3) *peripheral* (kinds which do not occur at the escarpment). The latter we again grouped as eastern, western, southern or northern.

We found good evidence of the existence in the state of 38 kinds of anurans, 18 salamanders, 44 lizards, 93 snakes, and 23 turtles, making a total of 216. Fifty-six per cent (122) of the total Texan herpetofauna (with a range of from 50 to 67 per cent among the 5 groups) reach the escarpment. Of these, 77 per cent (94) are limited there, and 11 per cent (total range 1 to 42 per cent) are endemic.

Not all of the range limits considered here are sharply marked off. Among those designated as limited by the escarpment, there may be a slight overstepping, particularly at the Del Rio and Waco ends where the escarpment levels out. In a number of cases the eastern portion of the escarpment forms a sharply defined boundary of the range of the species or subspecies while the southern face is insignificant and the range extends southward over it or beyond the entire southern portion of the Rio Grande. In all such cases it is obvious that low humidity, which occurs in an area similarly outlined, is more significant than any other factor. Species thus partially limited (i.e., by only the eastern face of the plateau) we have nevertheless tabulated as "limited."

It is obvious that no two independent analyses by different investigators are likely to arrive at exactly the same conclusion, since estimates of poorly known ranges must at the present time be highly arbitrary. Likewise arbitrary is the extent of overlapping of the escarpment accepted as commensurate with the definition of "limited" forms. These and other variables make the present estimates subject to later revision.

Anurans. There are 38 forms of the order Salientia whose reported occurrence in Texas is unquestioned. Of these, 50 per cent reach the escarpment. About half of the remaining 50 per cent are of eastern distribution, and most of these belong to the genera *Hyla* and *Rana,* whose requirements for a humid climate are apparently so restricted that they are unable to range as far west as the escarpment.

Of the frogs and toads that do reach the Balcones region, 74 per cent find their range limits there. Most of these are eastern frogs whose requirements for an aquatic habitat cannot be met extensively enough beyond the escarpment. Western forms which find their eastern limit there are toads and spadefoots adapted to a xeric type of habitat. Two frogs, *Eleutherodactylus latrans* and *Syrrhopus marnockii,* are adapted to the limestone ledges, cliffs, and caves that front the Edwards Plateau, and are endemic to this area. The species may be tabulated as follows.

LIMITED BY ESCARPMENT

Western	Eastern
Bufo cognatus	*Bufo valliceps valliceps*
Bufo debilis	*Hyla cinerea cinerea*
Bufo punctatus	*Hyla versicolor chrysoscelis*
Scaphiopus couchii	*Pseudacris clarkii*
Scaphiopus hammondii	*Pseudacris streckeri*
	Rana catesbeiana
	Scaphiopus hurterii

Endemic
Eleutherodactylus latrans
Syrrhopus marnockii

OCCURRING ON BOTH SIDES

Acris crepitans
Bufo compactilis
Bufo woodhousii woodhousii (mostly west)
Microhyla olivacea
Rana pipiens

NOT REACHING ESCARPMENT

Western
Bufo insidior
Hyla arenicolor
Scaphiopus bombifrons
Syrrhopus gaigeae

Southern
Bufo horribilis
Hyla baudinii baudinii
Hypopachus cuneus cuneus
Leptodactylus labialis
Syrrhopus campi

Eastern
Bufo woodhousii fowleri
Hyla crucifer crucifer
Hyla femoralis
Hyla squirella
Hyla versicolor versicolor
Pseudacris nigrita triseriata
Microhyla carolinensis
Rana areolata areolata
Rana clamitans
Rana palustris

Salamanders. Of the 18 kinds of salamanders whose reported occurrence has been verified, 67 per cent occur at the escarpment, and all of these are at their range limits. The five kinds endemic (or autochthonous) to the escarpment are correlated in distribution with the caves and cave waters, artesian wells, and spring-fed streams of the area. All but one of the non-endemic salamanders are eastern or southern forms. Since this group of amphibians is more restricted to an aquatic environment than is any other group under consideration, it is the one affected most by the change towards drier conditions at the Balcones region. The species may be tabulated as follows.

LIMITED BY ESCARPMENT

Western
Ambystoma tigrinum mavortium

Southern
Diemictylus meridionalis

Endemic
Eurycea latitans
Eurycea nana
Eurycea neotenes
Plethodon glutinosus albagula
Typhlomolge rathbuni

Eastern
Ambystoma texanum
Ambystoma tigrinum tigrinum
Manculus quadridigitatus
Plethodon glutinosus glutinosus
Siren intermedia nettingi

NOT REACHING ESCARPMENT

Eastern
Ambystoma maculatum
Ambystoma opacum
Ambystoma talpoideum
Amphiuma means tridactylum
Desmognathus fuscus brimleyorum
Diemictylus viridescens louisianensis

Lizards. Forty-four lizards are recorded in Texas, and 52 per cent of them reach the escarpment. Of these, all but two (95 per cent) are limited at the fault area. In contrast to amphibians, which require water for at least a stage of their life history, the reptiles are much more tolerant of the dry conditions on the Edwards Plateau: there are more western species limited by the escarpment than there are of eastern and southern species. The reverse is true of amphibians. The species of lizards are as follows.

LIMITED BY ESCARPMENT

Western
- *Cnemidophorus gularis gularis*
- *Coleonyx brevis*
- *Crotaphytus collaris collaris*
- *Eumeces brevilineatus*
- *Eumeces obsoletus*
- *Gerrhonotus liocephalus infernalis*
- *Holbrookia texana*
- *Sceloporus poinsettii*
- *Sceloporus undulatus consobrinus*
- *Urosaurus ornatus ornatus*

Southern
- *Eumeces tetragrammus*
- *Sceloporus variabilis marmoratus*

Eastern
- *Anolis carolinensis*
- *Cnemidophorus sexlineatus*
- *Eumeces fasciatus*
- *Eumeces laticeps*
- *Holbrookia propinqua*
- *Leiolopisma laterale*
- *Ophisaurus ventralis*
- *Sceloporus undulatus hyacinthinus*

Endemic
- *Holbrookia maculata lacerata*

OCCURRING ON BOTH SIDES
- *Phrynosoma cornutum*
- *Sceloporus olivaceus*

NOT REACHING ESCARPMENT

Western
- *Cnemidophorus grahamii*
- *Cnemidophorus gularis octolineatus*
- *Cnemidophorus perplexus*
- *Cnemidophorus tesselatus tesselatus*
- *Crotaphytus collaris baileyi*
- *Phrynosoma douglassii hernandesi*
- *Phrynosoma modestum*
- *Sceloporus magister magister*
- *Sceloporus merriami merriami*
- *Eumeces gaigei*
- *Eumeces multivirgatus*
- *Eumeces taylori*
- *Gambelia wislizenii wislizenii*
- *Holbrookia maculata approximans*
- *Sceloporus merriami annulatus*
- *Urosaurus ornatus schmidti*
- *Uta stansburiana stejnegeri*

Eastern
- *Eumeces anthracinus*

Southern
- *Crotaphytus reticulatus*
- *Sceloporus grammicus disparilis*
- *Sceloporus cyanogenys*

Snakes. Of the 93 species or subspecies of snakes for which we find authentic records from Texas, 53 range up to or across the escarpment; 57 per cent of the ophidian fauna is thus involved in the escarpment area. Of those involved, 70 per cent are limited by the escarpment. Most of the forms not reaching the cliffs are western species. Only ten are eastern species, including three forms of *Natrix* and one of *Farancia*. The species of snakes which are limited are divided almost equally among mesic eastern forms and xeric western or southern forms, indicating a wide range in physiological adaptivity—wider by all odds than in any other reptilian or amphibian order or suborder. The species may be tabulated as follows.

LIMITED BY ESCARPMENT

Western
- *Agkistrodon mokeson laticinctus*
- *Arizona elegans elegans*
- *Crotalus molossus molossus*
- *Crotalus viridis viridis*
- *Diadophis punctatus docilis*
- *Gyalopion canum*
- *Hypsiglena ochrorhyncha texana*
- *Lampropeltis getulus splendida*
- *Lampropeltis triangulum gentilis*
- *Leptotyphlops dulcis*
- *Masticophis taeniatus ornatus*
- *Rhinocheilus lecontei tessellatus*
- *Sonora episcopa*
- *Thamnophis eques cyrtopsis*

Eastern
- *Agkistrodon mokeson mokeson*
- *Agkistrodon piscivorus leucostomus*
- *Crotalus horridus atricaudatus*
- *Diadophis punctatus stictogenys*
- *Haldea striatula*
- *Haldea valeriae elegans*
- *Heterodon contortrix contortrix*
- *Lampropeltis getulus holbrooki*
- *Lampropeltis triangulum amaura*
- *Micrurus fulvius tenere*
- *Natrix grahamii*
- *Natrix sipedon confluens*
- *Sistrurus miliarius streckeri*
- *Tropidoclonion lineatum*
- *Tantilla gracilis*
- *Storeria occipitomaculata occipitomaculata*
- *Thamnophis sirtalis sirtalis*

Southern
- *Coluber constrictor stejnegerianus*
- *Masticophis taeniatus schotti*
- *Sonora taylori*
- *Tantilla nigriceps fumiceps*

Endemic
- *Natrix harteri*
- *Thamnophis rufipunctatus* (in this area)

OCCURRING ON BOTH SIDES

- *Coluber constrictor flaviventris*
- *Crotalus atrox*
- *Elaphe laeta laeta*
- *Elaphe obsoleta confinis*
- *Heterodon nasicus nasicus*
- *Lampropeltis calligaster calligaster*
- *Masticophis flagellum testaceus*
- *Natrix erythrogaster transversa*
- *Natrix rhombifera rhombifera*
- *Opheodrys aestivus*
- *Pituophis catenifer sayi*
- *Salvadora lineata*
- *Sistrurus catenatus tergeminus*
- *Storeria dekayi texana*
- *Thamnophis marciana*
- *Thamnophis sauritus proximus*

NOT REACHING ESCARPMENT

Western

Agkistrodon mokeson pictigaster
Crotalus lepidus lepidus
Crotalus lepidus klauberi
Crotalus scutulatus scutulatus
Diadophis regalis regalis
Elaphe bairdi
Elaphe subocularis
Hypsiglena ochrorhyncha ochrorhyncha
Lampropeltis alterna
Leptotyphlops humilis segregus
Leptotyphlops myopica dissecta
Masticophis taeniatus taeniatus
Salvadora grahamiae
Salvadora hexalepis deserticola
Sonora semiannulata blanchardi
Tantilla atriceps
Tantilla nigriceps nigriceps
Thamnophis macrostemma megalops
Thamnophis sirtalis parietalis
Trimorphodon wilkinsonii

Northern

Diadophis punctatus arnyi
Ophcodrys vernalis blanchardi

Eastern

Agkistrodon mokeson austrinus
Carphophis amoena vermis
Coluber constrictor constrictor
Crotalus horridus horridus
Farancia abacura reinwardtii
Masticophis flagellum flagellum
Natrix cyclopion cyclopion
Natrix erythrogaster erythrogaster
Natrix sipedon clarkii
Rhadinaea flavilata

Southern

Coniophanes imperialis imperialis
Drymarchon corias erebennus
Drymobius margaritiferus margaritiferus
Ficimia streckeri
Heterodon nasicus kennerlyi
Lampropeltis triangulum annulata
Leptodeira annulata septentrionalis
Masticophis taeniatus ruthveni

Turtles. The turtles are considerably less tolerant of environmental conditions than other reptiles. There are 23 species of freshwater turtles authentically reported in Texas, 15 of which reach the faulted area. Ten of the latter, or 67 per cent, are restricted. All but one of these are eastern or southern species. Perhaps one reason for the relatively high percentage of range limitations among the turtles is that proper egg-laying conditions are not found on the Edwards Plateau. The soil is so thin and rocky on the plateau that only a small percentage of the area provides soil of sufficient depth and proper texture for burying eggs. The species may be listed as follows.

LIMITED BY ESCARPMENT

Eastern

Amyda mutica
Chelydra serpentina serpentina
Graptemys pseudographica kohnii
Kinosternon subrubrum hippocrepis
Macrochelys temminckii
Sternotherus carinatus
Sternotherus odoratus
Terrapene carolina triunguis

Southern

Gopherus berlandieri

Endemic

Graptemys pseudogeographica versa

OCCURRING ON BOTH SIDES

Amyda emoryi
Kinosternon flavescens
Pseudemys floridana texana
Pseudemys scripta elegans
Terrapene ornata

NOT REACHING ESCARPMENT

Western

Chrysemys picta bellii
Kinosternon sonoriensis
Pseudemys scripta gaigeae

Eastern

Deirochelys reticularia
Malaclemmys pileata littoralis
Terrapene carolina major
Pseudemys floridana hoyi
Pseudemys floridana mobilensis

DISCUSSION

Importance of Escarpment Area. In Table 1 are summarized the effects of the Balcones Escarpment on the distribution of various groups of amphibians and reptiles. The alligator (*Alligator mississippiensis* Daudin) occurs in Texas, but is not included in the table. About 56 per cent of the 216 amphibians and reptiles recorded for Texas reach or cross the escarpment. The Balcones region forms a natural range limit for 77 per cent of the 122 forms involved in the area. The variation among the different groups is from 67 to 100 per cent. Least influenced are turtles, and next in order of increasing influence are snakes, anurans, lizards, and finally salamanders. The variation is correlated with habitat preferences, physiological tolerances, and life history requirements.

It is of interest to note that the percentage of forms reaching the escarpment area varies relatively little (50 to 67) among the five groups studied. In other words (1) these groups are nearly equally well distributed over the central part of the state, and (2) the proportion of the fauna of the state occurring in the escarpment area is sufficiently large to be of significance as a basis for zoögeographic considerations of general import.

Somewhat similarly indicative is the comparison of the combined counts for all groups of (1) eastern plus northern species and (2) western species, which include most (all but 22) forms in the state with the deletion of the endemic forms. A ratio of virtually 1-1 is obtained (76 western, 79 eastern plus northern).

Limiting Effect of Escarpment. Of those reaching the escarpment, 77 per cent are limited in range at that point, or, as a corollary, 23 per cent occur on both sides. If this were accepted as a general indication, it may be stated that a 75 per cent degree of differentiation in the herpetofauna at any boundary would be required to match the category into which the escarpment bound-

TABLE 1

SUMMARY OF EFFECTS OF ESCARPMENT

Group	Anurans	Salamanders	Lizards	Snakes	Turtles	Total
I. Number in state	38	18	44	93	23	216
II. Number not reaching escarpment	19	6	21	40	8	94
III. Number reaching escarpment	19	12	23	53	15	122
IV. Number limited	14	12	21	37	10	94
V. Endemics	2 (10%)	5 (42%)	1 (4%)	2 (4%)	1 (7%)	11 (9%)
VI. Number on both sides	5	0	2	16	5	28
VII. Per cent reaching escarpment	50	67	52	57	65	56
VIII. Per cent limited	74	100	95	70	67	77
IX. Per cent, VI of III	26 (11)	0	5	30	33 (7)	23
X. Ratio, W to E + N in II + IV	0.5 (9-17)	0.1 (1-11)	3.1 (28-9)	1.2 (34-29)	0.3 (4-13)	1.0 (76-79)
XI. Ratio, W to E, in IV	0.7 (5-7)	0.2 (1-5)	1.4 (11-8)	0.8 (14-17)	0.1 (1-8)	0.7 (32-45)
XII. Ratio, W to E + N, in II	0.4 (4-10)	0.0 (0-6)	17.0 (17-1)	1.7 (20-12)	0 6 (3-5)	1.3 (44-34)

ary may be placed. However, a different figure has been arrived at for the birds (56 per cent), a deficiency which may be attributed to the aerial habits of most birds.

Such wide differences in range limitation of the several groups belonging to only two classes of vertebrates at such a conspicuous natural boundary as that formed by the Balcones Escarpment indicate that consideration of all groups—plant and animal—is extremely important in designating the biotic areas of this region of Texas.

It is not improbable that, when adequately known in detail, some "index" group, as for instance the amphibians and reptiles, could be used at least tentatively to establish boundaries of biotic areas. A fairly precise table of correlation should be worked out in advance between the per cent of limitation (or differentiation) and rank of the biotic area.

The degree of endemism (autochthony is not distinguished) is not high. Not all cases counted are clear-cut, and those that are admitted average only 9 per cent for all groups, with a variation of from 42 per cent in salamanders to 4 per cent in snakes and lizards. Endemism apparently varies with extent of isolation from competition, not with degree of adaptability. Salamanders find conditions conducive to isolation more than any other group, inhabiting there, as they do, numerous well-separated artesian drainage systems. Frogs and turtles with their dependence upon humid conditions, find a lesser degree of opportunity for isolation. Least opportunity for isolation is offered to snakes and lizards, and in these the least endemism is found.

Differentiation Contours. The percentage of limitation at the escarpment exhibited by reptiles and amphibians is relatively high. It is obvious that the percentage decreases to the north and south, as the sharpness of the boundary lessens. This phenomenon—distinctness of a barrier in one area, and a gradual lessening of importance away from that area - suggests the value of plotting degree of differentiation of a given fauna by lines spaced at a given interval as for instance 10 per cent. The lines resulting would resemble physiographic contour lines, with a close approach of the lines in areas of great differentiation, a spreading in areas of little differentiation as in the Great Plains. Such contours, if constructed, would aid greatly in the evaluation of biotic provinces.

Differentiation contours in theory would have the advantage of combining the features of the "biotic province" and the "life zone" concepts, each of which by itself is deficient as a measure of natural areas. And again, differentiation contours lend themselves not only to W-E differentiation but also N-S or any other directional line of differentiation.

The difficulties of constructing such contours on a large scale as for the entire United States are such that the idea may be impractical for a number of years; however, it is at least a possible means of natural mapping that deserves consideration.

Degree of Tolerance. Data furnished by the distribution of the herpetofauna in the Balcones Escarpment area offer a means of establishing at least roughly the degree of tolerance by the various groups concerned of the varying conditions occurring in the area (see Table 2). To be considered separately are the average tolerance of the species and the tolerance of the group as a whole. These might well be considered jointly, save for the fact that while numerous species of a given group may overlap a given boundary like the escarpment, the group as a whole is concentrated on one side or the other of the same boundary.

TABLE 2
SUMMARY OF POSSIBLE INTERPRETATIONS

	Indications		Group
Criteria	Tolerance	Status of Group	Allocation
Unbalanced X-Y ratio High percentage of boundary overlap	group—low species—high	minor, ascendent	———
Balanced X-Y ratio High percentage of boundary overlap	group—high species—high	dominant, ascendent	Serpentes
Unbalanced X-Y ratio Low percentage of boundary overlap	group—low species—low	minor, descendent	Anura Caudata Lacertilia Chelonia
Balanced X-Y ratio Low percentage of boundary overlap	group—high species—low	dominant, descendent	———

Degree of tolerance is expressed by two sets of data: by the degree of overlap at the escarpment, and by the ratio of western forms to eastern forms. For these analyses it is preferable to consider only forms reaching the plateau, disregarding the entire state fauna, in order to eliminate a possible source of error introduced by artificial location of political boundaries. The extent of overlap appears to be an index to degree of tolerance of individual species, while the West-East ratio (hereafter called x-y ratio for the sake of brevity and to permit application to situations in which different cardinal directions may be involved from the simple West-East ratio that is important in this particular case) appears to be an index to degree of tolerance in the group as a whole.

Species of salamanders, with the least crossing and with next to the most unbalanced x-y ratio, are obviously the least tolerant of all, individually and as a group, of the varied conditions exhibited in the escarpment area. Species of lizards are next, with very little overlap and a distinctly unbalanced x-y ratio (in favor of the western group); obviously lizards are relatively intolerant of mesic conditions. In anurans a rather high per cent of crossing occurs, and the x-y ratio is less unbalanced; as a group they have been able to adjust more successfully to all the peculiar variations in the area of the escarpment than either salamanders or lizards. The data on crossing are undoubtedly distorted, however, due to the fact that anurans, like turtles, can live under essentially mesic conditions near or in streams that penetrate far into areas of xeric conditions. Although five forms are listed as crossing over, three demand mesic conditions, and therefore the actual per cent of crossing might better be regarded as nearer 10 than 26. There is still a higher percentage of crossing in snakes, and a more closely balanced x-y ratio; snakes are indicated as the most tolerant of all groups considered. Turtles, with an apparently high degree of crossing, are incorrectly allocated by these data, since all but one of those crossing the area are aquatic and thus are not subject to the same limiting factors that affect the distribution of the other groups. The tolerance of turtles is better indicated by the extremely unbalanced x-y ratio, which would mark them as even less tolerant than salamanders.

Status of Groups. Among the five groups comprising the herpetofauna of the escarpment area only two combinations of crossing percentages and x-y ratios are represented: (1) a high percentage of crossing combined with a balanced x-y ratio (Serpentes only), and (2) a low percentage of crossing combined with an unbalanced x-y ratio (Anura, Caudata, Lacertilia, Chelonia). There are, however, theoretically two other combinations possible: (3) a high percentage of crossing with an unbalanced x-y ratio, and (4) a low percentage of crossing with a balanced x-y ratio.

It is not unreasonable to suppose that groups with a low tolerance as a whole (an unbalanced x-y ratio) are *minor* groups, as compared with *dominant* groups which possess a high tolerance as a whole. In like fashion, groups whose species possess high tolerance may be considered as *ascendent,* inasmuch as their species are capable, at the present time, of investigating and inhabiting a wide variety of niches; these are distinct from *descendent* groups whose species have become adapted morphologically for life under certain set conditions and do not enter territories with widely different conditions.

Accordingly, snakes may be regarded as now a dominant and ascendent group, vigorous in an evolutionary sense; all other groups here considered

(anurans, salamanders, lizards, turtles) are minor and decadent groups probably receding in importance on the evolutionary scale.

CONCLUSIONS

1. The herpetofauna in the area of the Balcones Escarpment is 77 per cent limited, with a variation from 67 to 100 per cent in the five groups considered.

2. This per cent of limitation is greater than for birds (56 per cent).

3. "Biotic area" boundaries, indicated therefore by such widely varying degrees of limitation, should be considered on the basis of all groups—plant and animal—concerned.

4. "Index" groups to biotic areas should, however, have some significance when correlations are established between degree of limitation and rank of area.

5. An autochthony of 9 per cent is present and may be correlated approximately with a limitation of an entire fauna of about 77 per cent.

6. Differentiation (or Limitation) Contours may be more useful than either Life Zones or Biotic Provinces in mapping the biota of large areas.

7A. Degree of tolerance in gross terms can be interpreted for individual species and for groups as a whole, from data on percentage of crossing and on *x-y* ratio, respectively.

7B. Likewise the evolutionary status (i.e., whether dominant or minor, ascendent or descendent) of groups can be determined also from crossing percentages and from x-y ratio.

a. Much crossing of an unbalanced fauna indicates a high specific and low group tolerance, and occurs in minor ascendent groups.

b. Much crossing of a balanced fauna indicates a high specific and high group tolerance, and occurs in dominant, ascendent groups.

c. Little crossing of an unbalanced fauna indicates a low specific and low group tolerance, and occurs in minor, descendent groups.

d. Little crossing of a balanced fauna indicates a low specific and high group tolerance, and occurs in dominant, descendent groups.

8. Snakes are regarded as a dominant and ascendent group.

9. Anurans, salamanders, lizards, and turtles are all regarded as minor, descendent groups.

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Bulletin
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The Reptiles and Amphibians of Eastern Central Illinois

Philip W. Smith

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The Bulletin of the Chicago Academy of Sciences was initiated in 1883 and volumes 1 to 4 were published prior to June, 1913. During the following twenty-year period it was not issued. Volumes 1, 2, and 4 contain technical or semi-technical papers on various subjects in the natural sciences. Volume 3 contains museum reports, descriptions of museum exhibits, and announcements.

Publication of the *Bulletin* was resumed in 1934 with volume 5 in the present format. It is now regarded as an outlet for short to moderate-sized original papers on natural history, in its broad sense, by members of the museum staff, members of the Academy, and for papers by other authors which are based in considerable part upon the collections of the Academy. It is edited by the Director of the Museum with the assistance of a committee from the Board of Scientific Governors. The separate numbers are issued at irregular intervals and distributed to libraries and scientific organizations, and to specialists with whom the Academy maintains exchanges. A reserve is set aside for future need as exchanges and the remainder of the edition offered for sale at a nominal price. When a sufficient number of pages have been printed to form a volume of convenient size, a title page, table of contents, and index are supplied to libraries and institutions which receive the entire series.

Howard K. Gloyd, Director of the Museum

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Bulletin of the Chicago Academy of Sciences

The Reptiles and Amphibians of Eastern Central Illinois

Philip W. Smith*

The publication of a list of amphibians and reptiles collected in eastern central Illinois is, in part, a response to many inquiries by local teachers of high school biology and by herpetological investigators of other areas. Since very little survey work on the herpetology of this area has been done, this list to some extent should satisfy their need. This paper summarizes and considerably extends information in a number of previous articles treating the species of limited portions of this region (see Hankinson, 1915, 1917; Peters, 1942).

This area is of special interest because it represents three ecological zones: prairie, the eastern beech-maple forest, and the more westerly oak-hickory forest. The greater portion of the entire area has been extensively cultivated for many years, and the herpetological fauna has been adversely affected by the reduction of suitable natural habitats.

The writer is very grateful to Drs. C. S. Spooner and W. M. Scruggs of the Zoölogy Department at Eastern Illinois State Teachers' College for encouragement and many helpful suggestions. My wife, Dorthy M. Smith, prepared the accompanying map. Mr. K. P. Schmidt assisted greatly with many valuable suggestions. The writer is especially grateful to Drs. H. M. Smith and H. H. Ross for their constructive criticism of this paper, and to Dr. H. K. Gloyd for critical comments on some of the specimens studied.

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MATERIALS AND METHODS

The greater portion of the specimens recorded from this area were collected by myself or my associates and are deposited in the Illinois Natural History Survey collection and in the museum of the Eastern Illinois State Teachers' College.

This study represents ten years of intensive field work. Well over a thousand specimens have baen examined, and many others observed in the field. Due to limited museum space, it was impossible to retain all specimens collected or observed; hence, the relative abundance of the species in nature is not necessarily reflected by either the lists of localities or by the numbers of specimens recorded. In an attempt to obtain additional locality records, a survey has been made of the larger high schools of the region and their locality records added when the place of collection was definitely known. Visual records have also been used in the remarks following the list of localities

In the list of amphibians and reptiles of the area described, the name of the animal is followed by the counties and localities from which specimens were collected. The number of museum specimens from each locality is enclosed in parentheses, and the present disposition of material is designated by capital letters as follows:

INHS—Illinois Natural History Survey
EISTC—Eastern Illinois State Teachers' College
SHS—Shelbyville High School
MHS—Mattoon High School
GHS—Greenup High School
RJS—Robinson Junior High School
NHS—Newton High School

DESCRIPTION OF THE AREA

The area treated is within a radius of fifty to seventy miles from Charleston, Illinois, and embraces the following counties: Edgar, Clark, Crawford. Jasper, Cumberland, Coles, Douglas, Shelby, and Effingham. The Shelbyville moraine, which in eastern Illinois marks the southern limit of Wisconsin glaciation, roughly divides the region into northern and southern halves (Fig. 1). The elevation ranges from approximately 500 feet to slightly less than 800 feet above sea-level. Principal streams are the Embarrass River, Little Wabash River, and Mill Creek which flow into the Wabash River; and the Kaskaskia River which flows into the Mississippi.

A great variety of habitats exists within this area, but it is divisible into two principal zones: the prairie north of the moraine, and the forested region south of the moraine. The latter may be subdivided into the oak grove savanna and the beech-maple forest.

The prairie region has been recently glaciated and is heavily farmed. It embraces Edgar, Coles, and northern Shelby counties. Cultivation and drainage have transformed this land into almost continuous corn fields with the native vegetation remaining only along railroads and fence rows.

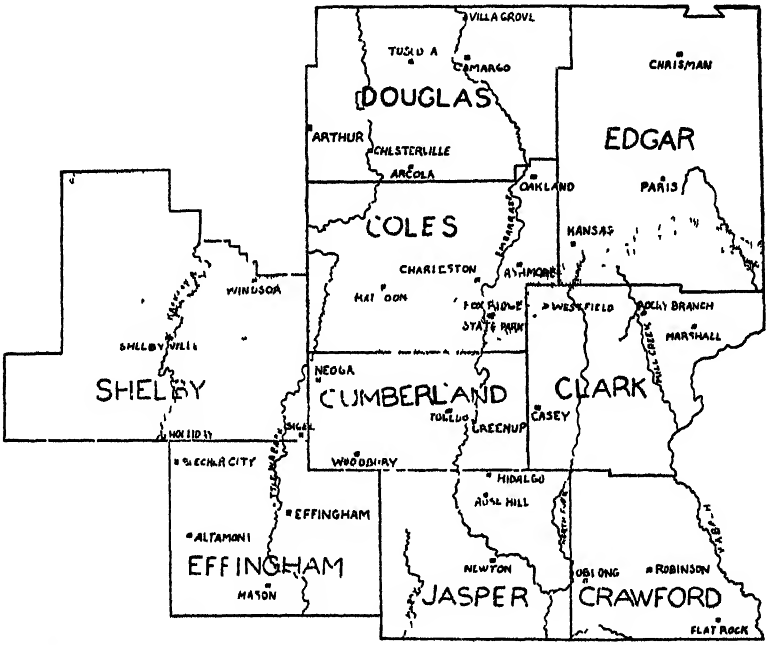

Figure 1. Map of the region studied. Stippled area represents the Shelbyville moraine.

The forested region south of the moraine consists of small hills, rapidly eroding ravines, some farmed bottom lands, and infrequent outcroppings of limestone, sandstone, or shale. The upland, when allowed to remain idle, soon supports thickets of oak, hickory, and berry brambles. Bottom lands and stream margins consist of cottonwood, sycamore, and willow associations.

Along the eastern margin in Clark and Edgar counties, "islands" of beech-maple forest occur, but these represent only a small zone within the area studied.

The moraine and its outwash plain make up a narrow belt from two to fifteen miles wide, similar in vegetation and animal life to the clay hills and ravines located to the south

ANALYSIS OF DISTRIBUTION

Analysis of distribution of species occuring in this region is rendered very complex by a number of factors The ranges of the species are affected not only by the major ecological zones but also by distinctly different habitats available in each.

Altogether 56 forms have been found in this area Sufficient data have been assembled for 50 of these to indicate their relation to ecological zonation as shown in the tabulation below For six species—*Ambystoma texanum*, *A tigrinum tigrinum*, *A maculatum*, *A opacum*, *Rana areolata circulosa* and *Storeria dekayi wrightorum*—the available information does not seem to warrant definite ecological assignment, and these have been omitted from the lists *Triturus viridescens* and *Desmognathus fusca*, included in the annotated list of species based on specimens recorded by Hankinson, have also been omitted since his specimens have apparently been lost, and these species have not been collected since Further collecting may reveal additional species now unknown, altering computations made here

ECOLOGICAL DISTRIBUTION OF SPECIES

A Species generally distributed over the entire area

AMPHIBIANS

Necturus maculosus maculosus
Hyla crucifer crucifer
Hyla versicolor versicolor
Acris gryllus blanchardi
Pseudacris nigrita triseriata
Rana catesbeiana
Rana pipiens pipiens

REPTILES

Opheodrys vernalis
Natrix sipedon sipedon
Thamnophis sirtalis sirtalis
Coluber constrictor flaviventris
Lampropeltis calligaster calligaster
Sistrurus catenatus catenatus
Amyda spinifera spinifera
Chelydra serpentina
Sternotherus odoratus
Chrysemys picta marginata
Pseudemys scripta troostii
Graptemys geographica
Graptemys pseudogeographica pseudogeographica
Terrapene carolina carolina

B. Predominantly prairie species and subspecies

1. Species known to reach their southern limit of distribution at the Shelbyville moraine in eastern Illinois

REPTILES

Lampropeltis triangulum triangulum
Natrix kirtlandi
Elaphe vulpina vulpina
Emys blandingii

2. Prairie species occurring farther south in other parts of their ranges but apparently limited to north of the moraine in eastern Illinois

AMPHIBIANS

Bufo terrestris americanus

REPTILES

Thamnophis radix radix
Natrix grahamii

C. Predominantly woodland forms

1. Species known to reach their northern limit of distribution at about the Shelbyville moraine in eastern Illinois

AMPHIBIANS

Plethodon glutinosus glutinosus

REPTILES

Sceloporus undulatus hyacinthinus
Eumeces laticeps
Leiolopisma laterale
Opheodrys aestivus
Lampropeltis triangulum syspila

2. Woodland species occurring farther north in other parts of their ranges but apparently limited to south of the moraine in east-central Illinois

AMPHIBIAN

Rana sylvatica sylvatica
Bufo woodhousii fowleri

REPTILES

Eumeces fasciatus
Storeria occipitomaculata
Haldea valeriae elegans
Carphophis amoena helenae
Diadophis punctatus edwardsii
Elaphe obsoleta obsoleta
Heterodon contortrix contortrix
Lampropeltis getulus niger
Agkistrodon mokeson mokeson
Crotalus horridus horridus
Amyda mutica
Terrapene ornata

3. Species apparently restricted to beech-maple forest.

AMPHIBIANS

Plethodon cinereus cinereus
Eurycea bislineata bislineata
Rana clamitans

The generally distributed forms are found throughout this area with no marked zonation. In the main they have a wide distribution.

With few exceptions the prairie species reach their southern limit of range in this area. This limit is especially marked with the species under B1. Exceptions occur with the species listed under B2, for each of which isolated records are known south of this area in prairie "islands."

Likewise, many of the woodland forms reach their limit of range in this region. This break is marked with the species in group C1 and coincides with the cessation of forest at the moraine. Species and subspecies listed in C1 do extend considerably farther north in parts of their ranges but appear to be absent from the prairie in the circumscribed area here studied. This may be due to the absence of suitable habitats.

Eurycea bislineata bislineata reaches the extreme western limit of its range in eastern Illinois. *Plethodon cinereus cinereus* and *Rana clamitans* are widely distributed forms, however, and their endemism appears to be the result of strict habitat preferences.

Schmidt (1938) in his admirable paper on the steppe fauna of North America correlates the following eleven species with the "prairie peninsula": *Ambystoma tigrinum, Rana pipiens, Heterodon nasicus, Coluber constrictor flaviventris, Terrapene ornata, Elaphe vulpina, Natrix kirtlandii, Thamnophis butleri, Sistrurus catenatus, Emys blandingii,* and *Chrysemys picta marginata.* Of these eleven he lists the last six as endemic. In eastern Illinois the southern limit of the ranges of *Elaphe vulpina, Natrix kirtlandii,* and *Emys blandingii* coincides with the margin of Wisconsin glaciation. *Sistrurus catenatus* and *Chrysemys picta marginata,* however, have been taken considerably south of the Shelbyville moraine; and accordingly, do not appear to belong in the same category. On the other hand, it is believed that *Lampropeltis triangulum triangulum, Natrix grahamii,* and *Bufo terrestris americanus* should be included in this group. The milk snakes of the Charleston region are obviously *triangulum-syspila* intergrades, while the single specimen from Douglas County is definitely *L. triangulum triangulum.* Likewise, the Jasper County specimen is a fairly typical *syspila. Natrix grahamii* and *Bufo terrestris americanus* are not strictly endemic but are predominantly prairie species.

FAUNISTIC CONCLUSIONS

There is an almost line-like division between black soil prairie north of the moraine and the clay soil savanna south of the moraine. When the herpetological fauna was tabulated with respect to these two areas, over half the species were found to exhibit a similar division coinciding with the landscape aspect areas. This is shown in the following table.

SUMMARY OF DISTRIBUTION
Expressed in Percentages

	Apparently limited to south of the moraine	Limited to north of the moraine	Total number exhibiting endemism	Known to occur both north and south of moraine	Unknown
Salamanders	37.5	0	37.5	12.5	50
Anurans	27.2	9.1	36.3	54.5	9.1
Lizards	80	0	80	20	0
Snakes	50	22.7	72.7	22.7	4.5
Turtles	18.1	9.1	27.2	72.7	0
All Groups	42	12.5	53.5	35.7	10

The above data indicate that, quite apart from climate, the two principal habitats themselves exert a critical influence in limiting the distribution of at least half the herpetological fauna. Many environmental factors are responsible, but an evaluation of these will need special intensive study.

ANNOTATED LIST OF SPECIES

AMPHIBIANS

Caudata Salamanders

Necturus maculosus maculosus (Rafinesque). Waterdog.

Coles Co.—Charleston (2) EISTC. *Cumberland Co.*—Greenup (1) INHS. *Shelby Co.*—Shelbyville (1) SHS.

This wholly aquatic salamander is probably much more common than the locality records indicate. It has not been taken in pond or lake habitats nor in the smaller streams of this region, but fishermen frequently catch them on hook and line in the Embarrass River in the early spring. As many as a dozen have been taken in a single morning of fishing near Charleston. One

or two specimens were present in nearly all the high school biology laboratories visited. While these were usually without collecting data, the instructor usually stated that they had been taken locally and were not supply house specimens.

Triturus viridescens louisianensis (Wolterstorff). Newt.

Hankinson reported a single specimen from Charleston, but his specimen has apparently been lost. The absence of recent records may be due to the extensive cultivation of most of the area.

Ambystoma tigrinum tigrinum (Green). Tiger Salamander.

Coles Co.—Charleston (5) INHS. *Cumberland Co.*—Greenup (1) GHS *Jasper Co.*—Newton (1) NHS. *Crawford Co.*—Robinson (2) RJS.

Nearly every spring there are brought to the Teachers' College laboratories a half dozen specimens of this salamander that have been taken in cellars, meter boxes, etc. It probably occurs in suitable habitats throughout the region, but records are lacking from the prairie counties. Schmidt (1938) lists this species as one of the steppe peninsula forms but does not indicate it as endemic. Most of the specimens taken under natural conditions were near very old ponds. The absence of such ponds in Douglas, northern Edgar, and northern Coles counties may account for the lack of prairie records.

Ambystoma maculatum (Shaw). Spotted Salamander.

Coles Co.—Charleston (2) INHS.

This form has been taken only at a small pond within the city limits of Charleston. Both specimens were under tar paper about 100 feet from the edge of the pond. The species is apparently much less common than *A. tigrinum*.

Ambystoma opacum (Gravenhorst). Marbled Salamander.

Richland Co.—Olney (1) EISTC.

A single individual was found under a pile of leaves at the Ridgeway Arboretum near Olney. Richland County has not been included in the area studied here; but since the arboretum lies only eight miles south of the Jasper County line, further search may reveal this species in suitable habitats in more northern localities.

Ambystoma texanum (Matthes). Small-mouthed Salamander.

Coles Co.—Charleston (5) INHS. *Cumberland Co.*—Greenup (1) INHS. *Jasper Co.*—Newton (1) NHS. *Shelby Co.*—Shelbyville (2) SHS. *Crawford Co.*—Robinson (2) RJS.

Probably the most common salamander of this area. Many specimens are brought to the Teachers' College each spring and fall. During the drain-

ing of an old pond near Greenup in March of 1937, 81 adult specimens were collected under sticks, leaves, and logs in the course of two or three hours. It has often been found crawling about in fields during the rainy nights of March and April. No records are available from the prairie of the area studied, but specimens have been taken in the adjoining counties to the north. Further collecting will probably reveal specimens from Edgar and Douglas counties.

Desmognathus fuscus fuscus (Rafinesque). Dusky Salamander.

This is another form reported by Hankinson from near Charleston for which the specimens have apparently been lost. A careful search of supposedly suitable habitats near Charleston has failed to reveal more recent records.

Plethodon cinereus cinereus (Green). Red-backed Salamander.

Clark Co.—Rocky Branch (8) EISTC, (6) INHS

This is another salamander which is apparently restricted to the beech-maple forest with rock outcroppings. It is moderately common at Rocky Branch and seems to prefer logs and stones on the higher land to the more wet conditions along the stream edge.

Plethodon glutinosus glutinosus (Green). Slimy Salamander.

Effingham Co.—Effingham (6) INHS, Mason (5) INHS. *Shelby Co.*—Shelbyville (1) INHS.

Locality records thus far indicate the slimy salamander to be of spotty occurrence in this region. It is quite common under logs and in stumps near Effingham, Mason, and Shelbyville. These three localities have in common small limestone bluffs and many decaying logs. Further search may reveal additional specimens from other localities with similar habitats. The above localities are considerably farther north than Bishop indicates in the *Handbook of Salamanders* (1934). The species probably does not extend north of the moraine in Illinois.

Eurycea bislineata bislineata (Green). Two-lined Salamander.

Clark Co.—Rocky Branch (23) EISTC, (10) INHS, Marshall (5) INHS.

The extreme western range limit of this salamander apparently lies in this area. It is abundant at Rocky Branch, a small "island" of beech-maple forest with many sandstone outcroppings, about three miles northeast of Clarksville. Repeated searches of similar outcroppings farther west have failed to furnish other records. In March, April, and May, adult specimens are very common in the creek and under stones at the stream margin.

Salientia—Frogs and Toads

Bufo terrestris americanus **Holbrook.** American Toad.

Douglas Co.—Chesterville (1) INHS. *Coles Co*—Charleston (5) EISTC, Fox Ridge State Park (3) INHS.

Moderately common near Charleston and very common on the prairie of Douglas and northern Coles counties. It has not been taken by us south of Fox Ridge State Park. The species begins calling in mid-April in the Charleston area and continues until mid-May.

Bufo woodhousii fowleri **Hinckley.** Fowler's Toad.

Effingham Co.—Effingham (1) INHS. *Jasper Co.*—Rosehill (5) INHS. *Coles Co.*—Charleston (4) EISTC, Fox Ridge State Park (12) INHS. *Cumberland Co.*—Greenup (2) INHS. *Shelby Co.*—Holliday (2) INHS.

Fowler's toad probably occurs throughout this part of Illinois, but is much more common south of the Shelbyville moraine. Near Charleston this toad and *B. terrestris americanus* appear to be equally common. *B. woodhousii fowleri* ordinarily does not enter the breeding pools until after *americanus* has ceased calling. This has been suggested as an important factor in preventing the two species from hybridizing.

Acris gryllus blanchardi **Harper.** Cricket Frog.

Coles Co.—Ashmore (45) EISTC, Charleston (3) EISTC, Fox Ridge State Park (5) INHS.

These frogs are exceedingly common in this area and probably are present in every permanent pool and stream. They are very late breeders in central Illinois. The season appears to be from mid-May through July.

Pseudacris nigrita triseriata **(Wied).** Striped Tree Frog.

Coles Co.—Charleston (5) INHS, Fox Ridge State Park (9) INHS. *Clark Co.*—Rocky Branch (2) INHS. *Cumberland Co.*—Greenup (10) EISTC.

Abundant in nearly every pool and ditch in early March but rarely taken in the summer and fall. Probably occurs throughout the region.

Hyla crucifer crucifer **Wied.** Spring Peeper.

Coles Co.—Charleston (6) INHS, Fox Ridge State Park (12) INHS. *Cumberland Co.*—Greenup (8) EISTC.

One of the most abundant frogs of the region. It is seldom taken in summer and autumn, but nearly every pool in March and April contains breeding individuals. It probably occurs over the entire area. *Hyla crucifer,*

Pseudacris nigrita triseriata, and *Rana sylvatica* appear to be not only the first frogs to emerge from hibernation but also the earliest breeders. The earliest breeding date for these species in this region is March 2. Peepers usually continue calling until late April and have been collected in the breeding pools in late May. Those calling so late in the season, however, usually had recommenced during or following a heavy rain. Such heavy showers have been observed to result in other species calling long after the peak of their breeding season.

Hyla versicolor versicolor **(LeConte).** Common Tree Frog.

Coles Co.—Fox Ridge State Park (2) INHS, Charleston (4) INHS. *Jasper Co.*—Rosehill (2) INHS. *Shelby Co.*—Shelbyville (2) SHS. *Effingham Co.*—Mason (2) INHS.

Tree frogs of this species probably occur throughout this region. Specimens can be collected nearly as successfully on dead branches, in deserted woodpecker holes, or under bark in September and October as in the breeding pools. Breeding appears to be from mid-May through most of June in central Illinois.

Rana areolata circulosa **Rice and Davis.** Gopher Frog.

Coles Co.—Charleston (3) INHS. *Cumberland Co.*—Toledo (2) INHS, Greenup (1) INHS.

In addition to those from the localities listed, others have been seen near Neoga in Cumberland County. No specimens are available from the prairie of Douglas, Edgar, and northern Coles counties. In this region the breeding season seems to depend on the mildness of the spring. The earliest date known to us is March 7. The period of calling from the pools appears to be less than three weeks except for occasional individuals that recommence during very heavy rains.

Rana catesbeiana **Shaw.** Northern Bull Frog.

Cumberland Co.—Greenup (1) INHS. *Coles Co.*—Charleston (4) EISTC, Fox Ridge State Park (5) INHS. *Crawford Co.*—Robinson (1) RJS.

Bull frogs are moderately common in ponds, small streams, and rivers. They probably occur throughout the region. Breeding is from late May through most of June. Occasional individuals may be heard as late as July.

Rana clamitans **Latreille.** Green Frog.

Clark Co.—Rocky Branch (3) INHS.

Rare in this area. Specimens have been taken at Rocky Branch, a habitat already discussed. Attempts to find other locality records have thus far been unsuccessful.

Rana pipiens pipiens Schreber. Leopard Frog.

Cumberland Co.—Greenup (1) EISTC. *Jasper Co*—Rosehill (2) INHS. *Coles Co.*—Charleston (11) EISTC, Fox Ridge State Park (14) INHS. *Crawford Co.*—Robinson (1) RJS. *Shelby Co.*—Holliday (2) INHS. *Clark Co.*—Marshall (1) INHS.

This is the most mommon *Rana* of central Illinois and it undoubtedly occurs in most of the ponds and streams of this region. Breeding extends from mid-March into June.

Rana sylvatica sylvatica (LeConte). Wood Frog.

Coles Co.—Charleston (2) EISTC, Fox Ridge State Park (11) INHS. *Effingham Co.*—Mason (1) INHS.

Wood frogs appear to be of spotty occurrence in this part of Illinois. They are quite common near Mason, near Charleston, and in Fox Ridge State Park. Woodland seems to be the only similarity in the three localities. Specimens have been taken every month in the year in Fox Ridge State Park. It is one of the first species to breed in the spring.

Leg length ratios for ten frogs were found to vary between .567 and .658 with an average of .605. This character and the comparative smoothness of the skin between the dorsolateral folds place them fairly definitely in the subspecies *sylvatica*.

REPTILES

Sauria—Lizards

Sceloporus undulatus hyacinthinus (Green). Swift.

Effingham Co.—Mason (4) INHS, Effingham (3) INHS. *Shelby Co.*—Shelbyville (7) SHS, (1) INHS.

This lizard is apparently restricted to wooded areas with limestone outcroppings. It and the salamander, *P. glutinosus*, have nearly always been taken together in this area. The northern limit of its range lies in this region.

Ophisaurus ventralis (Linnaeus). "Glass Snake."

Douglas Co.—Chesterville (1) INHS.

A single specimen was found crossing the highway near Chesterville in June of 1941. The place of its capture was about 100 yards from the Kaskaskia River, which in that vicinity is closely bordered by cornfields. Repeated searches of that area have revealed no others. While there are no records from the counties south of the moraine in the circumscribed area treated, the species is known to occur in southern Illinois. Probably this is a form that has become nearly exterminated in Illinois as a result of the extensive cultivation.

Leiolopisma laterale (Say). Brown-backed Skink.

Jasper Co.—Rosehill (4) EISTC, (1) INHS. *Effingham Co.*—Mason (1) INHS.

Common near Rosehill and occasional near Mason. These localities probably represent the northern limit of the range of this species.

Eumeces fasciatus (Linnaeus). Common Five-lined Skink.

Jasper Co.—Rosehill (8) EISTC. *Clark Co.*—Rocky Branch (1) EISTC. *Effingham Co.*—Mason (2) INHS. *Cumberland Co.*—Toledo (1) INHS.

This skink is commonly associated with *E. laticeps* and equally abundant in the wooded areas south of the moraine. It has been collected above the moraine in other parts of Illinois; but in the region here considered, a rather thorough search has failed to reveal prairie records.

Eumeces laticeps (Schneider). Greater Five-lined Skink.

Effingham Co.—Effingham (1) INHS. *Cumberland Co.*—Toledo (1) INHS, Greenup (1) INHS. *Coles Co.*—Charleston (1) INHS, Fox Ridge State Park (3) INHS. *Jasper Co.*—Rosehill (1) INHS. *Clark Co.*—Marshall (2) INHS.

Moderately common in wooded areas of the moraine and to the south. In eastern Illinois the northern limit of its range appears to coincide exactly with the moraine.

Serpentes—Snakes

Carphophis amoena helenae (Kennicott). Worm Snake.

Effingham Co.—Effingham (1) INHS.

This species is represented by a single specimen collected near Effingham in 1928.

Diadophis punctatus edwardsii (Merrem). Ring-necked Snake.

Coles Co.—Charleston (1) INHS.

A single large specimen was found under a flat stone in a shale outcropping near Charleston. Slightly more than half of the ventral scutes have medial spots. Otherwise, it is typical of *edwardsii*.

Heterodon contortrix contortrix (Linnaeus). Hog-nosed Snake.

Coles Co.—Charleston (2) EISTC, Fox Ridge State Park (4) INHS. *Shelby Co.*—Shelbyville (3) SHS. *Crawford Co.*—Robinson (1) RJS. *Cumberland Co.*—Greenup (1) INHS.

With the exception of the common water snake, this species is probably our most abundant snake. No records are present from the prairie of the

northern counties as yet; but it has been seen DOR* in many localities on the moraine and southward.

Opheodrys aestivus (Linnaeus). Keeled Green Snake.

Jasper Co.—Rosehill (1) INHS. *Effingham Co.*—Mason (1) EISTC. *Cumberland Co.*—Greenup (1) INHS. *Coles Co.*—Charleston (2) INHS, Fox Ridge State Park (2) INHS. *Crawford Co.*—Robinson (1) RJS.

Green snakes are moderately common in wooded areas and pasture lands south of the Shelbyville moraine. None have been seen north of the moraine. This species is most often collected after heavy summer showers.

Coluber constrictor flaviventris Say. Blue Racer.

Coles Co.—Charleston (2) EISTC, Fox Ridge State Park (1) INHS. *Jasper Co.*—(1) INHS. *Cumberland Co.*—Greenup (1) GHS. *Shelby Co.*—Shelbyville (2) SHS.

Moderately common in both prairie and woodland habitats.

Elaphe obsoleta obsoleta (Say). Pilot Black Snake.

Coles Co.—Charleston (1) EISTC, Fox Ridge State Park (3) INHS. *Jasper Co.*—Rosehill (2) INHS. *Cumberland Co.*—Neoga (1) EISTC, Greenup (2) GHS. *Shelby Co.*—Shelbyville (1) SHS.

Pilot black snakes occur commonly in wooded areas south of the Shelbyville moraine. None have been seen on the typical prairie of the northern counties. Near Rosehill a river bluff serves as hibernating headquarters for many of these snakes. In October it is not unusual to take six or eight large specimens in a single morning.

Elaphe vulpina vulpina (Baird and Girard). Fox Snake.

Douglas Co.—Arcola (1) INHS.

Although only one specimen was actually taken within the area here treated, this species is probably fairly common on the prairie of Coles, Edgar, and Douglas counties. DOR specimens have been seen repeatedly but a few miles north of the Douglas County line. It is believed that this form does not extend south of the Shelbyville moraine.

Lampropeltis calligaster calligaster (Harlan). Prairie King Snake.

Cumberland Co.—Toledo (1) INHS, Greenup (3) EISTC. *Coles Co.*—Charleston (1) EISTC, Loxa (1) EISTC, Fox Ridge State Park (3) INHS. *Shelby Co.*—Shelbyville (2) SHS, Sigel (1) INHS. *Crawford Co.*—Robinson (2) RJS.

Apparently equally common on the prairie and in the wooded areas farther to the south. Seen DOR in most of the localities within this region.

*Dead on road.

Lampropeltis getulus niger (Yarrow). Black King Snake.

Jasper Co.—Rosehill (1) INHS. *Cumberland Co.*—Diona (1) INHS.

This king snake seems to be quite rare in central Illinois. The Rosehill specimen was found in a rotton log in a wooded ravine. The other listed above was found DOR on the outwash plain near Diona. Another was seen DOR near Greenup in 1937.

Lampropeltis triangulum triangulum (Lacépède). Common Milk Snake.

Douglas Co.—Chesterville (1) INHS.

This subspecies is represented by a single large male collected on the prairie near Chesterville. The specimen is abnormal in having only 41 dorsal blotches, rather indistinct rows of lateral spots which tend to fuse with each other and the ventral spots, a peculiar head pattern, and a heavily mottled venter. The number and narrowness of the dorsal blotches and the presence of two alternating rows of lateral spots place it in this subspecies, however, and none of the characters, other than the reduced number of blotches, indicate it to be an intergrade. Instead, the dark brown of the dorsal blotches, the heavy pigmentation of the interspaces and venter, and the unusual head pattern suggest melanism.

Lampropeltis triangulum syspila (Cope). Red Milk Snake.

Coles Co.—Charleston (2) INHS, Fox Ridge State Park (2) INHS. *Jasper Co.*—Rosehill (1) INHS.

As stated earlier in this paper the milk snakes in the immediate vicinity of Charleston are intergrades of *syspila* and the preceding subspecies. However, all specimens taken at Charleston and Fox Ridge State Park agree in the small number of dorsal blotches, vivid red of the dorsal and lateral spots, and the presence of a single row of lateral spots. They exhibit intergradation in the varying head patterns and the width of the dorsal blotches. The characters designating *syspila* predominate, and they all key out to this subspecies. The single specimen from Jasper County appears to be a typical *syspila*. Milk snakes are not common in this region. Their favorite habitat seems to be wooded areas with many fallen trees. Most of the specimens taken at the above localities were found by stripping bark from decaying stumps and logs. One other individual was seen near Greenup.

Natrix grahamii (Baird and Girard). Graham's Water Snake.

Douglas Co.—Chesterville (1) INHS.

A single specimen was found near Chesterville in late November of 1941. Attempts to find others along the prairie streams have thus far been

unsuccessful. This is a prairie species, however, and may eventually be taken in northern Coles and northern Edgar counties.

Natrix kirtlandii (Kennicott). Kirtland's Water Snake.

Coles Co.—Charleston (3) INHS. *Douglas Co.*—Chesterville (2) INHS.

Moderately common near Charleston in both wooded areas and along prairie streams. Seen DOR near Tuscola and Arcola in Douglas County. Probably not uncommon throughout the prairie counties. None have been seen from the area south of the moraine.

Natrix sipedon sipedon (Linnaeus). Common Water Snake.

Cumberland Co.—Greenup (1) INHS. *Jasper Co.*—Hidalgo (1) INHS, Rosehill (2) EISTC. *Coles Co.*—Charleston (1) EISTC, Fox Ridge State Park (2) INHS. *Shelby Co.*—Shelbyville (1) SHS. *Douglas Co.*—Chesterville (2) INHS.

Abundant and probably occurring in every pond and stream in the region.

Storeria occipitomaculata occipitomaculata (Storer). Red-bellied Snake.

Cumberland Co.—Greenup (1) INHS.

Apparently this little snake is rare in the area. One other was seen near Charleston.

Storeria dekayi wrightorum Trapido. DeKay's Snake.

Cumberland Co.—Greenup (2) INHS. *Coles Co.*—Charleston (1) INHS, Fox Ridge State Park (1) INHS.

This species is moderately common near Charleston and probably occurs in pasture lands and woodland throughout this region. A small albino was found near the college campus in 1942. Unfortunately it escaped before it could be preserved.

Haldea valeriae elegans (Kennicott). Ground Snake.

Clark Co.—Rocky Branch (1) INHS. *Effingham Co.*—Effingham (2) INHS.

Evidently uncommon in this part of the state. Other specimens have been seen near Newton in Jasper County.

Thamnophis radix radix (Baird and Girard). Plains Garter Snake.

Coles Co.—Charleston (1) EISTC, Mattoon (2) MHS.

This species indicates a decided preference for the recently glaciated prairie. None have been seen south of the moraine, whereas DOR specimens have bees seen in many localities in Douglas and northern Coles counties.

Thamnophis sirtalis sirtalis **(Linnaeus).** Common Garter Snake.

Cumberland Co.—Greenup (1) EISTC. *Coles Co.*—Charleston (2) INHS, Fox Ridge State Park (3) INHS. *Jasper Co.*—Newton (1) INHS. *Shelby Co.*—Shelbyville (2) SHS.

Apparently common over the entire region. In addition to the specimens listed above, others have been seen from both the prairie of Douglas County and the wooded areas south of the moraine.

Agkistrodon mokeson mokeson **(Daudin).** Copperhead.

Cumberland Co.—Greenup (1) INHS.

The specimen listed above (a very young example) was found one-half mile north of Greenup at the base of a shale outcropping in September of 1937. Peters (1942) reported two more recently from the same vicinity. Farmers report seeing this species occasionally north of Effingham and there is little reason to doubt its presence as there are many limestone bluffs in that

Sistrurus catenatus catenatus **(Rafinesque).** Eastern Massasauga.

Fayette Co.—Vandalia (1) INHS.

The individual listed was taken near the State Penal Farm north of Vandalia. Several others have been seen by the writer from that area. This locality lies a few miles west of the area here considered, but the species has been included since others have been seen by the writer. A fine large example was captured near Diona in the fall of 1938, but apparently lost. It is reported as common at Parker's Prairie (outwash plain) north of Casey in Clark County.

Crotalus horridus horridus **Linnaeus.** Timber Rattlesnake.

Jasper Co.—Rosehill (1) INHS. *Coles Co.*—Charleston (2) EISTC.

This rattlesnake is of rare occurrence in this area. In addition to the museum specimens, others have been seen near Greenup and near Hidalgo.

Testudinata—Turtles

Sternotherus odoratus **(Latreille).** Musk Turtle.

Cumberland Co.—Woodbury (2) INHS. *Crawford Co.*—Robinson (1) INHS, Flatrock (1) EISTC. *Douglas Co.*—Camargo (1) INHS.

Musk turtles are very common in Lake Woodbury and probably occur in other ponds with suitable mud bottoms.

Chelydra serpentina (Linnaeus). Snapping Turtle.

Coles Co.—Charleston (1) EISTC, Fox Ridge State Park (1) INHS. *Douglas Co.*—Chesterville (1) INHS. *Shelby Co.*—Shelbyville (1) SHS, Holliday (1) INHS. *Crawford Co.*—Robinson (1) RJS.

The snapping turtle undoubtly occurs throughout this region in nearly all types of aquatic habitats. Specimens have been seen from most of the localities in the area studied.

Emys blandingii (Holbrook). Blanding's Turtle.

Cumberland Co.—Toledo (2) INHS.

Hankinson reported a specimen from a small prairie pond near Charleston, but it has evidently been lost. This turtle appears to be rare in this region. Both specimens from Toledo are very small.

Terrapene carolina carolina (Linnaeus). Common Box Turtle.

Effingham Co.—Mason (1) INHS. *Coles Co.*—Charleston (2) INHS, Fox Ridge State Park (2) INHS. *Cumberland Co.*—Toledo (2) INHS, Greenup (1) INHS. *Shelby Co.*—Shelbyville (4) SHS. *Jasper Co.*—Newton (2) NHS, Rosehill (1) INHS. *Crawford Co.*—Robinson (1) RJS.

Probably occurs throughout the area. A few specimens have been seen from the prairie of Douglas County, but it is much more common south of the Shelbyville moraine.

Terrapene ornata (Agassiz). Ornate Box Turtle.

Jasper Co.—Newton (1) EISTC. *Crawford Co.*—Robinson (2) INHS. *Effingham Co.*—Mason (2) INHS.

This box turtle is decidedly spotty in its occurrence, and its presence in widely differing habitats is not easily accounted for. Although it is reportedly a prairie form, it appears to be restricted to the savanna south of the moraine in this area. It has been found as often in woodlands in this portion of the state. Near Robinson it is nearly as common as *T. carolina*. Individuals have also been seen on the outwash plain north of Casey in Clark County.

Graptemys geographica (Le Sueur). Geographic Turtle.

Coles Co.—Charleston (1) INHS.

A very large specimen of this turtle was shot under the Embarrass River bridge near Charleston. No others have been seen by the writer.

Graptemys pseudogeographica pseudogeographica (Gray). False Map Turtle.

Cumberland Co.—Greenup (1) INHS. *Shelby Co.*—Shelbyville (1) INHS.

Several have been seen near Shelbyville and near Charleston.

Chrysemys picta marginata Agassiz. Painted Turtle.

Coles Co.—Charleston (1) INHS, Fox Ridge State Park (2) INHS. *Cumberland Co.*—Woodbury (4) INHS, Greenup (1) EISTC. *Douglas Co.*—Chesterville (1) INHS. *Shelby Co.*—Shelbyville (1) SHS. *Clark Co.*—Casey (1) INHS.

This form probably occurs in all permanent waters of this area. Specimens have been seen from most of the localities in this region. Occasional individuals approach *Chrysemys picta bellii* in the markings on the plastron.

Pseudemys scripta troostii (Holbrook). Troost's Turtle.

Cumberland Co.—Woodbury (3) INHS. *Crawford Co.*—Robinson (1) INHS. *Coles Co.*—Fox Ridge State Park (1) INHS.

This turtle probably occurs in lakes and large ponds throughout this region. Several have been seen in the campus lake at Charleston.

Amyda mutica (Le Sueur). Brown Soft-shelled Turtle.

Coles Co.—Charleston (3) INHS. *Jasper Co.*—Newton (1) NHS. *Shelby Co.*—Holliday (1) INHS.

The smooth soft-shelled turtle indicates a decided preference for rivers and for clean, sandy bottoms. This may account for the absence of records from the prairie counties. In the Embarrass River near Charleston, it and *spinifera* are equally common. However, *mutica* has not been taken from lakes or small streams.

Amyda spinifera spinifera (Le Sueur). Spiny Soft-shelled Turtle.

Coles Co.—Charleston (3) INHS. *Cumberland Co.*—Greenup (1) INHS. *Effingham Co.*—Effingham (1) INHS. *Crawford Co.*—Robinson (1) RJS.

Very common. Specimens have been taken in lakes, ponds, small streams, and in rivers. Near Charleston in midsummer, frequently twenty or more have been taken within a few hours by probing sand bars at the water edge. Some have been seen in the mud bottomed dredge ditches of northern Douglas County.

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Observations on *Batrisodes* (Coleoptera: Pselaphidae), with Particular Reference to the American Species East of the Rocky Mountains

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Observations on *Batrisodes* (Coleoptera: Pselaphidae), with Particular Reference to the American Species East of the Rocky Mountains[1]

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Northwestern University

CONTENTS

[1]This study has been facilitated by a grant from the Graduate School of Northwestern University to partially defray expenses involved in field collecting, in travel to study type specimens and collections, and expense incurred in preparing illustrations.

INTRODUCTION

The present paper is the result of a number of years of intermittent study upon species of *Batrisodes* that inhabit North America east of the Rocky Mountains. As such it is another increment in the gathering of materials for a general treatment of the pselaphid beetles of the Western Hemisphere, and consequently articulates with other incomplete studies by the author on the rich pselaphid fauna of the Neotropical Region, cited in the bibliography.

The genus is unknown from the neotropics (Park, 1942), but in America north of Mexico is an abundant, common, and important element of the pselaphid fauna. Although the species of *Batrisodes* comprise about one-seventh of the known North American species of Pselaphidae, and although Thomas Say, John L. LeConte, Emil Brendel, and Thomas L. Casey had described the great majority of the known species by the close of the last century, the genus is poorly known, either as a taxonomic or a zoögeographic unit.

The urgent need of a revision was noted by Bowman (1934, p. 57). Even today no satisfactory key to the females of the genus can be given. It was felt that the eastern species populations could be examined separately in this paper and a similar treatment of the western populations reserved for the accumulation of more data.

TAXONOMIC MORPHOLOGY OF THE GENUS

Some general remarks on the external anatomy of the species in the area under study are necessary to a proper evaluation of taxonomic characters, and to avoid needless repetition of detail in the diagnoses that follow.

In general, the species are elongate-cylindrical, reddish brown to black, with usually polished and conspicuously pubescent integuments. They range in size from about 2.7 mm. long for large specimens of *ionae* to about 1.4 mm. long for small specimens of *riparius*.

The large head is generally about as wide as long, and is usually longer than deep and often wider than the pronotum. The head may be elongate (*ionae*), but is more frequently transverse.

The lateral view of the head is valuable for an understanding of the several taxonomic regions and sclerites (Pl. I, 1, 2, 3). Starting at the posterior end, that portion of the head capsule that articulates with the prothorax is the *cervicum*. The cervicum usually is narrowed rapidly to a relatively slender neck that is separated from the head proper by the transverse *cervical sulcus*. Anteriad of this sulcus the head is usually rather abruptly arcuate to form the *occiput*, and in some species (*ionae*), the occiput is strongly tumid. The occiput is continuous anteriorly with the large *vertex*. This area extends from occiput, over the dorsal surface,

to the *antennal incisures*, and transversely from the dorsal border of one eye to the other. The antennal incisures are usually present as a notch or pubescent fovea just above and behind each antennal articulation. These incisures may be conspicuous (*globosus, frontalis*), slender sutures (*foveicornis*), or nearly closed (*lineaticollis*). The occiput-vertex is a useful area in the taxonomy of the genus. It may be densely pubescent to subglabrous, subimpunctate to coarsely punctate, or scabrous (*scabriceps*). Frequently the occiput, or vertex, or both are medianly, longitudinally carinate. This *median vertexal carina* may be absent (*sinuatifrons*), but is usually present, and may be highly developed, approaching a crest (*globosus*). It varies in length between the species, and to a certain extent its length and strength vary within the species population. It may extend from the center of the vertex, on a line with the antennal incisures, posteriorly over the occiput and well on the cervicum, or it may be a very short carina on the occiput.

The sides of the head, above each eye, are often evenly rounded into the dorsal surface of the head, but these margins may be quite sharp, or may bear a right and left *lateral vertexal carina*. These lateral vertexal carinae are especially well shown in *globosus*. Very seldom the vertex bears a small median indentation (*ionae*). All species bear a pair of *vertexal foveae*. These are pits on the vertex, one on each side, between the lateral vertexal carina and the median carina, usually on a line through the eyes. They may be very small (*ionae*) to large (*denticollis*); pubescent (*denticollis, schmitti, nigricans, striatus*), although a majority of species have the foveae nude (*globosus*). These foveae vary among the species in size, depth, pubescent or nude, distance apart, and position along the anteroposterior cephalic axis. Usually they are more or less connected superficially by an arcuate *circumambient sulcus* that extends from one fovea to another, as a broad, apically directed arc over the anterior half of the vertex. This sulcus is well developed in *globosus, furcatus* and *frontalis*, for example, but is much more often partially developed (*uncicornis*), and may be almost absent, and quite difficult to discern.

As a rule the occiput-vertex bears a lateral vertexal carina each side, and a median carina. In a few species, for example *cavicrus, armiger*, and *monstrosus*, the occiput bears, in addition to the median carina, a right and a left *oblique carina*. In such cases, these three carinae converge apically on the vertex.

Anterior to the top of the head, composed of occiput and vertex, the *face* of *Batrisodes* is composed of two sclerites, the *frons* or *front*, and the *clypeus*. This is a highly complex area and is important in taxonomy. It is frequently the best place to search for differences between species, as well as secondary sex characteristics.

In general terms, the front extends anteriorly, and often abruptly in a declivous plane between the antennal articulations, from the antennal incisures anteroventrally to the clypeus. Laterally the front embraces the *antennal cavities*, and extends posteriorly to the apical boundary of the eye.

The clypeus is usually continuous with the front dorsally, throughout its length, but ventrally is limited by the *clypeolabral suture.*

For general taxonomic purposes the topography of the front and clypeus may be considered together, as the face. All females have the face relatively simply formed, consisting of a long, declivous slope from the interantennal line to the clypeolabral suture, and in this sex the interspecies differences of the face affect such things as the degree of facial declivity, punctation, pubescence, and amount of narrowing of the face between the antennal cavities.

It is far otherwise in the males. The face may be relatively simple, in which case it is not separable from that region in the female of the same species, or the face may be excessively modified by deep excavations, spines, carinae, teeth, and peculiar pubescence. Such modifications may be used to separate species, as well as sexes.

In the present paper, the face is interpreted differently from previous American keys, in an attempt to avoid confusion in the minds of students who wish to discriminate the species yet do not have reliably named check-collections at hand. Previous keys often divided the species on whether the front was excavated between the antennae, or was not excavated. This sound practice lost its effectiveness when the amount of facial declivity was interpreted also as facial excavation, in addition to obvious, transverse excavation between the antennae.

For present purposes, therefore, we may consider the face as being transversely excavated between the antennae when a continuous transverse depression can be demonstrated from one antennal cavity to the other. Using this criterion, the males of eastern species would appear to separate into three groups: (1) deeply excavated, (2) slightly impressed, and (3) not excavated.

The first group is always easily discriminated. The front is deeply, transversely cleft between the antennal cavities, and far below the antennal articulations to the head capsule. This transverse cleft may be high or low, long to short, pubescent to nude, simple to armed. As a rule, when there is such a cleft, the clypeus is medianly elongated into a conspicuous spine, or the clypeus may be medianly elevated into a conspicuous spine, carina, or tubercle. Such a deeply excavated condition is illustrated (Pl. I, 1), and is exemplified by *globosus, frontalis, beyeri, scabriceps,* and *furcatus,* among others.

The second group is less easily recognized, unless the head is examined from a strictly lateral view. From a dorsal view, a slight transverse

impression between the antennal cavities may be overlooked, but in lateral view any entire transverse impression can be seen, and its indenting of the facial line observed in profile. This condition is illustrated (Pl. I, 2), and is exemplified by *foveicornis, cavicornis,* and *antennatus,* among others.

The third group lacks any entire, transverse impression between the antennal cavities. The facial declivity may be abrupt or gently declivous, the width of the declivity may be more or less uniform to the clypeal margin, or strongly narrowed between the antennal cavities, and may be densely punctate, scabrous, or almost impunctate, densely setose to subglabrous, medianly or bilaterally impressed in the dorsoventral axis. This condition is illustrated (Pl. I, 3), and is exemplified by *lineaticollis, fossicauda, declivis, schaumi, ionae,* and *monstrosus,* among others.

Ventrally from the clypeus, the *labrum* may be nearly vertical and relatively short (*globosus*) to relatively elongate and oblique to the dorsoventral axis (*lineaticollis*).

The *mandibles* are strong and well-developed in the genus. These structures, and the relatively simple *maxillary palpi* have not been used in the taxonomy of the genus, but have been discussed in general terms by Ganglbauer (1895), Raffray (1908), Reitter (1909) and Park (1942).

Laterally, the head capsule consists of vertex, front, clypeus and gena. The *compound eye* of each side is the meeting place for these four, more or less continuous, areas or sclerites. The eye is usually large, deeper than long, subconical in profile, subovate to subreniform from a direct lateral view, vertical to slightly oblique. It is often slightly hirsute, the setae arising between the facets, and usually becoming more dense posteriorly, where they merge with the extensive, and characteristic *genal beard.* The eye usually is relatively large, prominent and contains from forty to sixty facets that appear circular at most magnifications, the hexagonal character not being demonstrated without specially prepared microscope slides. Rarely, the eye is rudimentary. For example, the eye in *monstrosus* shows a sexual differentiation: the males have large eyes of between forty-eight and fifty-two facets, whereas the females have eyes only a fourth as large containing about twelve facets.

The *antennal cavities* are large, and variously formed among the species, as their peripheries are modified by consequence of the excavation of the face. Hence they tend to be circular where the face is not transversely indented or excavated, but may be confluent with each other, where the face is transversely modified. At the extreme dorsal rim of the antennal cavity is the articular surface of the first antennal segment. This may not be seen unless an antenna is removed. This articular surface appears extremely elongate oval from a lateral view, but is in reality circular, since the first antennal segment articulates dorsally to the head.

This articulation is an important pselaphid characteristic, as noted many years ago by Casey, Raffray and others. Where the antennal incisure is clearly defined, it may be seen just behind and above this articular area.

A number of carinae are usually present on the lateral surface of the head, and these serve to divide the surface into three taxonomic areas: (1) the supraocular, (2) preocular, and (3) subocular areas. The supraocular field is bounded dorsally by the lateral vertexal carina, anteriorly by the antennal incisure, and ventrally it may be clearly set off by a *supraocular carina* (Pl. I, 1), but this carina may be absent (Pl. I, 2, 3). The preocular field is bounded dorsally by the supraocular carina, when present, anteriorly by the usually sharply defined posterior limit of the antennal cavity, and ventrally by the long *clypeogenal carina.* The subocular field is comprised of the gena, and lies behind the eye, and below the clypeogenal carina. As previously noted, the eye is at the center of these three areas, and frequently the several carinae unite to form a *circumocular carina.*

The characteristic genal beard of *Batrisodes* has been noted. This continues over much of the ventral surface of the head. This surface is broad and relatively unmodified. Characteristically for the family, the gula is absent, the right and left genae meeting medianly in the *gular suture,* or this latter is vestigial to give a smooth genal surface. At the posterior margin of the genocervical constriction, a single *gular fovea,* or a pair of gular foveae may be present.

The chief appendages of the head utilized in the taxonomy of the genus are the *antennae.* These organs are composed of eleven segments, or *antennomeres.* They are labile structures in the eastern species of the genus, and exhibit many excellent structural abnormalities as between the species.

The females in general have simple, unmodified antennae, the segments being uniform elongate cylindrical to subquadrate. A signal exception is found in the females of *schaumi,* where the ventral face of the tenth antennomere is slightly flattened, and the seventh antennomere has the external apical angle produced in a triangular, dentoid, setose process similar to, but not as pronounced as in the males of the same species.

Before discussing antennal modification in the male sex, a few words must be written concerning the terms applied to the segments in the key, and diagnoses. The antennae are always described as though they were extended in a straight line in front of the head, and parallel to the long axis of the body. In such a position, each segment has an apex, base, dorsal face, ventral face, lateral or external face and a mesial or internal face.

The antennomeres that show abnormal modification are the first, third, seventh, ninth, tenth, and eleventh.

The first antennomere may have the ventral face inflated, with the inflated portion flattened and densely, minutely setose (Pl. II, 12) as in *schmitti;* it may have the ventral face produced into a flat, rounded lobe (Pl. II, 10) as in *denticollis,* or produced into a long, acute, triangular spine (Pl. II, 11) as in *nigricans;* it may bear a large oval, granulated concavity on its mesial face, as in *tridens,* or the mesial face may be divided lengthwise into a dorsal, flattened, smooth area and a ventral, flattened granulated area, as in *clypeonotus.*

The third antennomere may have the mesial face tumid to almost semicircular, while the lateral face is straight, as in *nigricans* (Pl. II, 11; Pl. VII, 5).

The seventh antennomere has the external apical angle strongly produced as a conical spine, at right angles to the long axis (Pl. II, 8) in *schaumi.*

The ninth antennomere may be from three to four times as wide as long, with the mesial face produced into a wide, thin, setigerous plate (Pl. II, 2), as in *riparius;* or the external apical angle may be produced in a long acute spine (Pl. II, 9), as in *antennatus.*

The tenth antennomere is often modified. It is frequently large, spherical to irregularly and transversely ovate, and in some species (*globosus* and several others) is distinctly wider than the last segment. The genus may be divided into two groups on the structure of the tenth segment. A great many species have the ventral face excavated, foveate, or both, whereas a number have the ventral face simply convex. In certain instances the fovea is nude (*globosus*), but it is usually pubescent. The fovea may be minute (Pl. II, 4), not more than a tenth of the length of the ventral face, or it may be a tremendous cavity, occupying four-fifths of the length of the ventral face (Pl. II, 3) as in *cavicornis.* The fovea may be perforate (Pl. II, 4), or constructed in several steps (Pl. II, 3); it may occupy any place on the ventral face, but is usually more basal than otherwise, and may lie within an excavation. Where the fovea is minute, and difficult to discern save with strong illumination and high magnification, it has been unnoted in certain instances by earlier writers, and the lack of information on this point has produced errors in later keys to the species. The ventral face may be flattened (Pl. II, 9), as in *antennatus,* or the segment may have the mesial face produced into an excavated, spinoid cone (Pl. II, 1), as in *uncicornis.*

Frequently the fovea is full of an alcohol-insoluble, white, friable secretion on pinned specimens. This may suggest a sensory function for the fovea of the tenth antennomere, similar to the pearly secretion of the palpal groove of certain neotropical hamotine pselaphids (Park, 1942).

The distal or eleventh antennomere is variously modified, but in other species is simply elongate, convex, uniformly pubescent, with a truncate

base and tapering apex. Some species (Pl. II, 5, 6) have the ventral face simply flattened over the basal half to two-thirds, as in *foveicornis*, or the ventral face may be flattened and bear a transversely oval concavity (Pl. II, 9), as in *antennatus*, or the ventral face may be deeply excavated or concave over most of its surface(Pl. II, 3), as in *cavicornis*. Another series of modifications affects the basal margin of the segment. In this development, the basal areas of the ventral face are produced into a spine, or a tooth. These spines vary in length and degree of obliquity within a given species population, but within this range of variation are species specific. *Batrisodes nigricans* has the basal bead of the ventral face produced into a just barely discernible denticle; *ionae* has a spinoid, inconspicuous, longitudinal ridge on the basal margin of the ventral face; in *schaumi* the spine is conspicuous, and slightly arcuate apically from the basal margin of the ventral face, whereas the basal spine is directed posteroventrally (Pl. II, 1, 2) in *riparius* and *uncicornis*.

In certain cases, the basal portion of the ventral face of the eleventh antennal segment apparently secretes a material similar to that of the foveal secretion of the tenth segment in color, consistency, and reaction to alcohol. This is all the more unusual as there is no foveal orifice, and the secretion must be formed from minute pores in the integument. Such a secretion is often noted in pinned specimens of *furcatus*, there being a large white conical mass of dried, or precipitated, material over the fovea of the tenth segment, and another similar mass on the eleventh segment, near the base on the ventral face. Such secretions should prove interesting biochemically, as between species.

The pronotum usually is as long as wide, arcuate on either side from the apical margin to reach its greatest width at about apical three-fifths, thence narrowing and more or less sinuate to the basal bead. At basal four-fifths there is a large *median fovea*, and on either side a right and a left *lateral fovea*. These three foveae are always present. From each fovea a longitudinal sulcus extends apically. The *lateral sulci* and *median sulcus* show a great deal of variation, both between species and, to a certain extent, within the species population. The median sulcus may be entire, extending from median fovea to the apical margin or nearly so, as in *lineaticollis*, to obsolete (*luculentus*). The lateral sulci are similarly variable but have not been used as much in the taxonomy of the species.

The pronotal integument is more or less longitudinally elevated on the intervals between these sulci, to form two *longitudinal carinae*, and basally each carina ends in a basal *spine*. There is great interspecies variation here as well. The sculpture may be quite sharp, with ridge-like carinae ending in acute, conical spines, or the carinae may be short, longitudinal tumuli and the spines reduced to low, inconspicuous tubercles. Generally the three foveae and two spines lie in a transverse antebasal row. The carinae may be periodically raised into denticles or short re-

curved spines, and the basal fifth may also contain accessory spines and foveae. Commonly, the median basal fovea is connected to the basal margin by a short longitudinal carina.

The elytra have been used relatively little in species separation. The humeral angles may be produced, each ending in an acute spine or tooth (*monstrosus*), or may be rounded and unarmed (*foveicornis*). At the base of each elytron, beneath the humeral angle is a *subhumeral fovea,* and on the dorsal surface three *basal elytral foveae,* the sutural, medial, and lateral. These foveae are usually nude, deep and well-formed. The lateral and sutural foveae lie at the origin of a short basal longitudinal sulcus, as a rule. The only species that does not have three basal elytral foveae is *ionae.* In this species both male and female sex have but two basal foveae on each elytron. The point has been made that *monstrosus* lacks the medial basal fovea, but this is incorrect. Both sexes of *monstrosus,* and the types of *carolinae* and *cavicrus* have three basal elytral foveae on each elytron. This is another illustration of how remote *ionae* really is from the other members of the genus under discussion.

The abdomen has five visible tergites and five visible sternites, and since there is no lateral margin to the tergites, the abdominal segments can be seen as continuous rings. This lack of margins is a critical character for the tribe Batrisini. The first tergite has two *lateral carinae* on each side, an external straight carina and an internal, more or less oblique carina. These carinae of the first tergite are distinct, and the subtriangular space enclosed between these carinae each side is analogous to the margin of this tergite in other pselaphid tribes of the area. The second and third tergites have lateral carinae, but these are quite small and not involved in the taxonomy of such a limited geographic area.

The base of the first tergite is divided into three deep depressions by a pair of *basal abdominal carinae.* These latter vary in size as between the species, and in amount of proximity, and hence the relative size of the basal depressions vary as well.

The first three abdominal segments are seen as continuous rings, but the fourth is laterally clearly divided by a suture into an obvious tergite and sternite, whereas the fifth segment has the tergite (often known as the *pygidium*) and fifth sternite freely movable dorsoventrally to allow voiding of waste products from the anus, and the extrusion of the aedeagus in the male.

The last (fifth visible) sternite is often modified in the male sex. This modification usually takes the form of a median depression, which may be transverse (*fossicauda*) or elongate (*bistriatus*). Another type of modification involves the posterior external portions of this sternite. These may be elevated into a right and left tumulus (*frontalis*), or into setose tubercles (*furcatus*).

The sternal foveae have not been utilized in the taxonomy of some groups. These have been discussed at length elsewhere (Park, 1942) and may form a future aid in species discrimination in *Batrisodes*.

The metasternum is usually more prominently swollen in the males than in the females, and is generally medianly impressed.

The large, membranous wings are fringed with long, delicate setae, and are used to support the animal during its dusk flight, discussed later

The legs are usually modified as between the sexes. Often this is a quantitative difference, the males having more swollen femora, especially the prothoracic, than the females. In addition, there are a number of qualitative modifications between the sexes, and since these are species specific, they are made use of in the taxonomy.

The prothoracic tibiae may be strongly produced at the center of the dorsal face to form a broadly triangular tooth (*monstrosus*), or a slender, acute spine (*armiger*) in the males, whereas the females have the tibiae unarmed in these species (Pl. III, 7).

The prothoracic tarsi may have the large primary claw simple in the male and female of a species (Pl. III, 9). This is the rule in the genus. On the other hand, a few species have the male with the primary claw distinctly bifid on the prothoracic tarsi (Pl. III, 10, 11), as in *furcatus*, *virginiae*, and *frontalis*.

The mesothoracic femur may have the dorsal face abruptly and semicircularly incised at apical third (*monstrosus* and *armiger*) in the males and simple in the females; or the ventral face may bear a long, arcuate, blunt spine at basal third (Pl. III, 8) in the males of *ionae* and *schaumi*, but the females have these femora normal.

The mesothoracic tibia may bear a long *tibial spur*, as in *globosus*, or the tibia may not have this spur, as in *cavicornis*. Again, the apical margin of the ventral face of this tibia may be extended as an acute spine as in *monstrosus*. The difference here is that the tibial spur is a long pencil of very approximate setae, whereas the apical spine is a solid, sclerotized portion of the integument.

The mesothoracic tarsi are especially important. Although previously unreported, the males of the eastern species may be abruptly separated into two groups, depending upon whether the mesotarsi are simple (Pl. III, 5) or abnormal (Pl. III, 6). As will be seen from the illustrations, in the simple type the second tarsal segment or *tarsomere* is compressed-cylindrical; in the abnormal type the second tarsomere is deeply incised on the ventral face.

The modification of the metathoracic legs is seen chiefly in the presence or absence of tibial spurs. This is a species specific rather than a sexual difference, but utilization of this character usually requires patience,

and has occasioned some confusion. Thus, a few eastern species lack metathoracic tibial spurs (*monstrosus, armiger, cavicrus, carolinae*). In this category the tibial apex bears no integrated pencil of setae (Pl. III, 3, 4). Second, *ionae*, although usually placed in the group lacking tibial spurs, and appearing on casual examination to agree in this particular, has a spur developed from the center of the ventroapical margin rather than from the side, and this peculiar condition is masked by a fringe of long setae on either side of pencil. Third, most species have distinct tibial spurs developed on the side of the tibial apex, but these spurs may be short and acute (Pl. III, 2), as in *globosus*, or long and truncate (Pl. III, 1), as in *foveicornis*.

The tarsi of the metathoracic legs are usually simple, the last two segments being compressed-cylindrical (Pl. III, 1, 2, 3). In *armiger* the second tarsomere is greatly swollen and ovate (Pl. III, 4).

The *aedeagus* has been discussed in general phylogenetic terms, as well as specifically for eastern species of American *Batrisodes* (Park, 1942, p. 15-17, Pl. I, II, III). It is important both for the finer discrimination of closely allied species, and to obtain a broad view of pselaphid phylogeny. During the past five years more data have been accumulated, and these will be presented later.[2]

In the key that follows, the student must be able to sex the material at hand. Obviously, the best demonstration of sex in *Batrisodes* is the presence or absence of the aedeagus. This can be obtained by (a) direct dissection of the specimen, (b) examination of the cleared specimen in prepared slides, or (c) if the beetles are killed in ether, chloroform or carbon tetrachloride, the aedeagus will often be extruded. Even when collected in ethyl alcohol, this will sometimes occur.

If the aedeagus is not sought for, the specimen may still be sexed with a reasonable degree of success by observing whether or not it has one or more of the male secondary sex characters noted in the previous pages. To summarize these modifications, if a specimen lacks all of the following features it is probably a female; if it has two or more of the following features it is a male:

1. Front transversely excavated between the antennae.
2. Large eyes with more than twenty facets.
3. Front or clypeus bearing spines, teeth or tubercles.
4. Antennomeres I, III, VII, IX, X or XI all or partially abnormal.
5. Primary protarsal claw bifid.
6. Protibia bearing a dorsal tooth or spine.

[2] Morphological data on the aedeagus, and an accessory key to the species based on the aedeageal structure and form will be given in a paper nearing completion on the pselaphids of the Chicago Area.

7. Mesofemur abruptly incised dorsally in apical third, or bearing a large blunt spine ventrally at basal third.
8. Second tarsomere of middle leg abruptly incised on ventral face.
9. Second tarsomere of hind leg greatly swollen and wider than tibia.
10. Last visible sternite medianly depressed, or apically tuberculated on each side.

KEY TO MALES OF AMERICAN SPECIES OF BATRISODES EAST OF THE ROCKY MOUNTAINS

The following key to males of eastern species populations of *Batrisodes* is complete with respect to recognized species. It has been drawn up almost entirely from direct examination of type specimens, paratypes, and material compared with types by the author. There are six species for which this is not so. I do not know *clypeonotus* (Brendel), *tridens* Casey, *luculentus* (Casey), *virginiae* (Casey), *caseyi* Blatchley, or *kahli* Bowman. In these six cases original descriptions have been followed as much as feasible.

The illustrations on Plates I to VII are drawn to the same scale unless otherwise noted, from specimens in the author's collection, or from type specimens and paratypes in museum collections. As they have been drawn primarily for illustrating the keys, this will account for the absence of composite drawings of whole beetles, the lack of shading, and other details of pubescence and general punctation. The figures were all drawn under very strong illumination, with 6.8 objectives and 9 × oculars.

Since the key characters are discussed in the preceding section, this material should be studied before using the keys for identification of specimens.

1		Mesothoracic femur with a conspicuous, blunt, slightly arcuate, subcylindrical spine at basal third of posteroventral face (Pl. III, 8)	2
		Mesofemur not as above	3
2	(1)	Antennomere VII with the apex of external face gradually formed into an acute spine at right angles to the long axis of the segment (Pl. II, 8)	*schaumi* (Aubé).
		Antennomere VII not as above, transverse (Pl. II, 7)	*ionae* (LeConte).[3]
3	(1)	Metathoracic tibia with an apical spur (Pl. III, 1)	8
		Metathoracic tibia with apical spur absent (Pl. III, 3)	4

[3] Furthermore, *ionae* is the only species in the area under study that has only two basal foveae per elytron.

4 (3) Occiput with three apically converging carinae: a median, and a right and left oblique carina . . . 5

Occiput with a median longitudinal carina only . . . 7

5 (4) Prothoracic tibia with a large tooth or tubercle near center of dorsal face (Pl. III, 7) . . . 6

Prothoracic tibia not as above . . . *cavicrus* Casey.

6 (5) Second tarsomere of metathoracic tarsus greatly swollen and ovate, nearly as wide to wider than tibial apex (Pl. III, 4) . . . *armiger* (LeConte).

Second tarsomere of metathoracic tarsus simple, compressed-cylindrical, much narrower than tibial apex (Pl. III, 3) . . . *monstrosus* (LeConte).

7 (4) Pronotum with several acute, recurved spines in a longitudinal row on each side of disk . . . *carolinae* Casey.

Pronotal disk without these recurved spines . . . *confinis* (LeConte).

8 (3) Antennomere XI with a distinct basal spine (Pl. II, 1, 2) . . . 9

Antennomere XI with basal spine absent . . . 10 [4]

9 (8) Antennomere IX more than twice as wide as long, with the mesial face produced as a wide, thin, setigerous plate (Pl. II, 2) . . . *riparius* (Say).

Antennomere IX only slightly wider than long, and without the spinoid plate (Pl. II, 1) . . . *uncicornis* Casey.

10 (8) Antennomere X with the ventral face bearing a fovea or an excavation (Pl. II, 3, 4, 5, 9, 13; V, 4; VI, 1, 2, 5) . . . 11 [5]

Antennomere X with the ventral face simple, not foveate or excavated (Pl. VII, 1) . . . 26

11 (10) Vertexal foveae pubescent . . . 12

Vertexal foveae nude . . . 13

12 (11) Antennomere I with the ventral face produced ventrally as a conspicuous glabrous spine or a rounded-triangular process (Pl. II, 10, 11; VII, 5) . . . 38

Antennomere I with the ventral face simple, or very abnormal, but not as described above (Pl. II, 12) . . . 28

[4] The eleventh antennal segment of *nigricans* has the basal margin of the ventral face produced as a just discernible, minute denticle. This species is keyed out as though this denticle were absent.

[5] The fovea of the tenth antennal segment may be very conspicuous or so minute that it will be overlooked unless requisite illumination, magnification and care are used. The surface should be clean. The fovea may be central, basal or eccentric; deep and perforate, or in several steps; nude or pubescent.

13 (11) With the specimen oriented so that the face can be examined directly from the front or from a lateral view: the front is transversely excavated (Pl. I, 1), or is transversely impressed (Pl. I, 2) between the antennal cavities 18

With the specimen oriented as above: the front is simply declivous and strictly continuous with the clypeus, never transversely excavated or impressed (Pl. I, 3) 14[6]

14 (13) From a strictly lateral view, the rugosely punctured head has the vertex evenly convex, and the frontoclypeus is strongly declivous at an angle of about forty-five degrees (Pl. I, 3); last sternite with a median, rather deep excavation that is longer than wide (Pl. V, 1, 2) 15

From the same view, the rugosely punctured head is evenly declivous from a point between the eyes to the apical margin of clypeus at an angle of about twenty degrees; median depression of last sternite shallow, and slightly wider than long (Pl. V, 3) 17

15 (14) Median longitudinal sulcus of pronotum vestigial, not extending on disk; integument between the vertexal foveae lightly punctate *bistriatus* (LeConte).

Median longitudinal sulcus of pronotum long, extending on disk to apical four-fifths; entire top of head rugosely punctate 16

16 (15) Median excavation of fifth sternite entire, subacute-oval (Pl. V, 1) *lineaticollis* (Aubé).[7]

Median excavation of fifth sternite with subparallel sides, bluntly closed apical end, but basal end open on each side (Pl. V, 2) *cartwrighti* Sanderson.

17 (14) Head through the eyes not wider than pronotum; fovea of antennomere X large, covering basal three-fourths of ventral face *fossicauda* Casey.

Head through the eyes distinctly wider than pronotum; fovea of antennomere X smaller, covering basal half of ventral face *declivis* Casey.

18 (13) Antennomere X wider than XI (Pl. II, 4) 19

Antennomere X as wide as XI or narrower than XI (Pl. II, 5) 21

[6]This interpretation of the front must be clearly understood if the specimens are to key out correctly (see p. 48).

[7]I have not seen the type specimen of *lineaticollis* (Aubé). The standard of reference used was the example of this species in the LeConte collection.

19 (18) Front strongly produced anterior to a line passing through bases of first antennal segments 20

Front abruptly declivous between antennal bases, this declivity densely setose and terminating in a pair of blunt median teeth *spretus* (LeConte).

20 (19) Lower margin of the overhanging frontal arc produced medianly into a thin, dark-brown, translucent triangular plate; this plate at right angles to the front, conspicuous, and turned ventrally at its apex (this may give the appearance of a pair of contiguous, right-triangular teeth over the deep frontal excavation) *beyeri* Schaeffer.

Lower margin of the overhanging frontal arc not produced, but medianly biarcuate, the median apex of the biarcuation, and the lateral apex each side continuing posteroventrally as carinoid ridges into the deep frontal excavation (Pl. I, 1); very common in the area *globosus* (LeConte).

21 (18) Antennomere XI with the ventral face normally convex 22

Antennomere XI with the ventral face abnormal in some particular, and dissimilar to the convexity of the dorsal face: flattened, concave, excavated, or medianly angulated (Pl. II, 3, 5, 6; VI, 5) 25

22 (21) Vertex between the foveae relatively smooth and impunctate to sparsely punctulate 23

Vertex between the foveae obviously, coarsely and densely punctate, granulate, or scabrous 39

23 (22) Occipitovertexal area bisected by a median longitudinal carina 24

This area with no trace of such a carina, the surface perfectly smooth and convex *schaefferi* new species.

24 (23) Mesothoracic tarsi normal (Pl. III, 5), the dorsal and ventral outlines of the second tarsomere parallel in lateral view 37

Mesothoracic tarsi abnormal (Pl. III, 6, 12), the ventral outline of the second tarsomere deeply notched in lateral view *rossi* new species.

25 (21) Antennomere XI elongate and as wide as X, with the ventral face flattened in basal half to basal two-thirds (Pl. II, 5, 6; VI, 5) 40

Antennomere XI distinctly wider than X, with the ventral face concave in basal two-thirds (Pl. II, 3) *cavicornis* Casey.

26 (10) Antennomeres II to X inclusive submoniliform, all wider than long ... *caseyi* Blatchley.
Antennomeres II to X not all wider than long ... 27

27 (26) Vertexal foveae pubescent ... *striatus* (LeConte).
Vertexal foveae nude ... 29

28 (12) Antennomere I with ventral face normally convex; ventral margin of overhanging front medianly developed into a pair of blunted, rounded-triangular teeth ... *striatus psotai* new variety.
Antennomere I with ventral face inflated ventrally, this inflation flattened and densely, minutely pubescent (Pl. II, 12); ventral margin of overhanging front developed into a small rounded-triangular lobe ... *schmitti* Casey.

29 (27) Antennal club abnormal: IX and X with ventral faces flattened; external apical angle of IX produced in a spinoid process; XI with ventral face flattened, and the basal half broadly and gently concave (Pl. II, 9) ... *antennatus* Schaeffer.
Antennal club not as described above ... 30

30 (29) Antennomere I with mesial face bearing a large, oval, minutely granulate-punctate concavity ... *tridens* Casey.
Antennomere I not as described above ... 31

31 (30) Antennomere I with mesial face flattened, this flattened area divided into a smooth dorsal and a granulated ventral portion ... *clypeonotus* (Brendel).
Antennomere I not as described above ... 32

32 (31) Median longitudinal pronotal sulcus long, extending from median basal fovea to near the apical pronotal margin ... 36
This sulcus short to obsolete, never extending to more than apical fourth of total pronotal length ... 33

33 (32) With the head seen directly from above, the front extends as a long, gradually angulated arc, the apex of which is on a line passing through the anteriorly directed apices of the first antennomeres ... *frontalis* (LeConte).
With the head seen directly from above, the front is declivous on a line passing through bases of the anteriorly directed first antennomeres ... 34

34 (33) An entire circumambient sulcus connects the two vertexal foveae ... 35
Circumambient sulcus not entire, deeply impressed near each vertexal fovea but wholly obsolete apically ... *luculentus* (Casey).

35 (34) Frontal declivity densely punctate, each fine puncture bearing a short, coarse, blunt, flavous seta *punctifrons* (Casey).
Frontal declivity less uniformly punctate, the punctures less abundant medially, and each puncture bearing a very fine, inconspicuous, hair-like seta (Pl. V, 9) *appalachianus* Casey.

36 (32) Median vertexal carina extending over occiput, vertex, and to the glabrous semicircular excavation of the frontal declivity (Pl. VII, 2) *temporalis* Casey.
Median vertexal carina not extending on the frontal declivity *kahli* Bowman.

37 (24) Anterior margin of clypeus ogival in outline, as seen from above, that is, arcuate-triangular with a median point *furcatus* (Brendel).
Anterior margin of clypeus transversely truncate *virginiae* (Casey).

38 (12) Antennomere III longer than either II or IV, the mesioventral face slightly to strongly swollen or tumid (Pl. II, 11; VII, 5) *nigricans* (LeConte).
Antennomere III slightly shorter than II, perfectly simple and elongate (Pl. II, 10) *denticollis* (Casey).

39 (22) Last sternite simply convex, with a small concave impression at basal fourth *sinuatifrons* (Brendel).
Last sternite medianly concave, with the apical angles produced into conspicuous, rounded tubercles *scabriceps* (LeConte).

40 (25) Face with the front declivous between antennal bases, the greatly narrowed declivity separated from the clypeus by a very shallow and feeble transverse impression, the declivity simple (Pl. I, 2) *foveicornis* (Casey).
Face with the front broadly arcuate and extended beyond the antennal bases, then declivous to a slightly undulated, sharply defined frontal margin; face transversely excavated beneath this margin, the excavation densely setose *hairstoni* new species.

TENTATIVE KEY TO THE FEMALES OF BATRISODES EAST OF THE ROCKY MOUNTAINS

The following key to females is tentative and admittedly incomplete. It is on a different qualitative level from that of the preceding key to males. In the first place, a great many species have been described upon the male sex alone. Of these latter species only a few have had the female sex later associated with them without reservation. The following key has been compiled on direct comparative examination of those females that could be given a definite name with reasonable assurance. Consequently the key covers only about half of the known species of *Batrisodes* in the area under study.

1 Eyes rudimentary, consisting of from 6 to 14 facets; tibia with apical spur absent (MONSTROSUS GROUP) (Pl. III, 3) 2
Eyes normal, prominent, consisting of 40 or more facets; tibia with apical spur present (Pl. III, 1, 2) 5

2 (1) Occiput with three apically converging carinae: a median, and a right and a left oblique carina 3
Occiput with only a median longitudinal carina *confinis* (LeConte).

3 (2) Lateral pronotal margin bearing a posteriorly directed spine on each side, behind middle of length (Pl. VI, 3) *sandersoni* new species.
Lateral pronotal margins lacking this spine (Pl. VI, 4) 4

4 (3) Relatively large, 2.4 to 2.6 mm. long *monstrosus* (LeConte).
Relatively small, 1.7 to 2.0 mm. long *cavicrus* Casey.

5 (1) Antennomere VII slightly abnormal, the external apical angle varying from being slightly produced to formed into a subtriangular tooth *schaumi* (Aubé).
Antennomere VII normal 6

6 (5) Each elytron with only two basal foveae *ionae* (LeConte).
Each elytron with three basal foveae (the sutural fovea may be inconspicuously placed near suture) 7

7 (6) Vertexal foveae pubescent (NIGRICANS GROUP) 8
Vertexal foveae nude 11

8 (7) Antennomere III slightly longer than II *nigricans* (LeConte).
Antennomere III distinctly shorter than II 9

9 (8) Frontoclypeal declivity bisected by a median longitudinal carina or carinoid ridge; lateral vertexal carinae strong and well-developed from temporal angles to antennal tubercles; median vertexal carina strong and entire from cervicum to center of vertex on a line apical to the anterior eye margins *schmitti* Casey.

Frontoclypeal declivity lacking median longitudinal carina or carinoid ridge; lateral vertexal carinae tending to be poorly developed, usually developed on temporal angles but not reaching antennal tubercles; median vertexal carina generally poorly developed, often only on cervicum and cervical sulcus, rarely extending to center of vertex 10

10 (9) Top of head distinctly and rather suddenly narrowed on a line passing just apical of anterior eye margins; apical clypeal margin tending to be upturned or medianly elevated *denticollis* (Casey).

Top of head much more square in outline, the narrowing anterior of the eyes much more gradual and slight; apical clypeal margin tending to be simple and not medianly elevated *striatus* (LeConte).

11 (7) Face between antennal tubercles very coarsely and conspicuously punctate or scabrous 12

Face between antennal tubercles smooth, shining, glabrous to minutely punctulate or minutely granulate 14

12 (11) Frontoclypeus very gently and uniformly declivous from front to apical clypeal margin; front and clypeus not obviously differentiated (LINEATICOLLIS GROUP) *lineaticollis* (Aubé).
bistriatus (LeConte).
fossicauda Casey.
declivis Casey.

Frontoclypeus vertically declivous 13

13 (12) Face uniformly and coarsely scabropunctate from interantennal line to ventral border of clypeus (SCABRICEPS GROUP)
scabriceps (LeConte).
temporalis Casey.

Face with front vertically declivous and coarsely scabropunctate, and clypeus conspicuously concave, finely granulated and ending in a thin, laminoid, apically-directed margin
sinuatifrons (Brendel).

14 (11) Face bisected longitudinally by a dorsoventral carina or a carinoid ridge from the interantennal line of the front to the apical margin of the clypeus; most common species in the area under discussion *globosus* (LeConte).
Face not as described 15

15 (14) Front and clypeus finely and densely granulate, granulate-punctate, or granulate-reticulate 16
Front (not necessarily clypeus) glabrous to sparsely punctate or sparsely granulate or undulated 17

16 (15) Humeral angle of each elytron armed with a small, distinct tooth; face relatively shining and less densely punctate-granulate *frontalis* (LeConte).
Humeral angle of elytra not armed; face densely granulate 19

17 (15) Looking directly into face, there is a transverse to concave interantennal roll connecting the antennal tubercles, and consequently the entire circumambient sulcus ends behind this roll 18
Looking directly into face, there is no interantennal frontal tumulus or transverse roll connecting antennal tubercles, and consequently the entire circumambient sulcus ends far forward, with the median portion of its wall on the frontal declivity *cavicornis* Casey.

18 (17) Looking directly downward on top of head, the interantennal roll between antennal tubercles is straight and transverse, and the face is subvertically declivous; humeral elytral angles smooth and rounded *beyeri* Schaeffer.
Looking directly downward on top of head, the frontal roll is indistinct and V-shaped, and appears to merge insensibly into the sloping facial declivity; each elytron with an oblique humeral tumulus armed at its posterior angle by a very minute denticle *furcatus* (Brendel).

19 (16) Median subbasal fovea of pronotum connected to basal bead of pronotum by a strong and entire carina *antennatus* Schaeffer.
This carina either wholly absent or not entire 20

20 (19) Integument between punctures smooth and polished *punctifrons* (Casey).
Integument between punctures very finely alutaceous *schaefferi* new species.

DIAGNOSES AND DISTRIBUTION OF PREVIOUSLY DESCRIBED SPECIES

In this section are discussed the several recognized species of the area under survey and their zoögeographic ranges.

There has been no attempt to redescribe each species in detail since a large part of this would be needless repetition of anatomy common to the genus as a whole. Rather, attention has been paid to the critical features of each population, especially with respect to the male sex.

These morphological matters are followed by the material examined in terms of collections studied and literature on the subject. I am indebted to many people for the privilege of studying the pselaphids under their care. In addition to private collections, noted in diagnoses that follow, I take this opportunity to thank W. J. Gerhard, Rupert Wenzel and Henry Dybas of the Chicago Natural History Museum (C.N.H.M.) for permission to study the collections of W. J. Gerhard, Dr. Frank Psota, H. F. Wickham, A. B. Wolcott, and F. W. Nunenmacher; H. S. Barber of the U. S. Bureau of Entomology and Dr. E. A. Chapin and Dr. R. E. Blackwelder of the U. S. National Museum (U.S.N.M.) for facilities in studying the Thomas L. Casey collection; Dr. Harlow B. Mills, the late Dr. T. E. Frison, Dr. H. H. Ross and Dr. Milton Sanderson for favors received while studying the pselaphids deposited at the Illinois Natural History Survey (I.N.H.S.); Dr. Hugo G. Rodeck for the loan of two pselaphids from the University of Colorado Museum; Dr. Joseph C. Bequaert for permission to study the John L. LeConte and the H. C. Fall collections at the Museum of Comparative Zoölogy (M.C.Z.).

Specimens in the author's private collection (O.P.) include the collection of the late Charles F. A. Schaeffer. [8]

Batrisodes ionae (LeConte)

Diagnosis: Male. This is a large, shining, heavy-bodied species. It is very isolated among the American species of the genus. The pubescence, although sparse, is long, more or less bristling and erect on head, pronotum and elytra, with the setal tips frequently sharply recurved. This gives a downy aspect to the body.

The antennae are massive for the genus, with segments, II, IV, V, VI, VII, VIII, IX and X transverse and III quadrate; VIII is distinctly smaller than VII or IX; ventral face of X flattened; XI with a short basal tooth at ventromesial corner.

[8] The type specimens of the pselaphids described by Charles Schaeffer, as well as some paratypes, are in the collections of the U. S. Bureau of Entomology; paratypes are in the author's collection. This note is appended to avoid possible confusion as to place of deposition of the type.

Occiput-vertex very tumid; top of vertexal tumidity with a median foveoid depression; no median vertexal carina; lateral vertexal carinae very sharp on posterior half of head; vertexal foveae small, deep, nude; face declivous, vertical between antennae, not transversely impressed or excavated, gular suture distinct, and gular fovea deep.

Last sternite with a deep, transverse impression near basal margin.

Each elytron with two basal foveae only.

Prothoracic legs with primary tarsal claw bifid. Mesothoracic legs with femur bearing a long, translucent, slightly arcuate, very blunt spine near center of ventroposterior face; tarsi normal. Metathoracic legs with tibia bearing a dense brush of setae on mesial face, a few of these setae longer at apical margin to give a false tibial spur.

Female. As for male save that the intermediate antennal segments are less massive; ventral face of X simply convex; XI without a basal spine. Primary claw of prothoracic tarsi not bifid; mesothoracic femur not bearing a spine. Last sternite shorter, with a more feeble and arcuate basal impression.

DISTRIBUTION

Published Records: Georgia (LeConte, 1850); Georgia (Brendel and Wickham, 1890); Vigo and Crawford Counties, Indiana (Blatchley, 1910); Georgia, Pennsylvania, Indiana (Leng, 1920; Bowman, 1934).

Material Examined: Slade, Powell County, KENTUCKY (O.P.); White Mountains and Summit, Union County, NEW JERSEY (O.P.); Enola, Cumberland County, PENNSYLVANIA (O.P.).

DISTRICT OF COLUMBIA (MCZ); GEORGIA (MCZ type 6158); Palisades, Bergen County and Lakehurst, Ocean County, NEW JERSEY (MCZ).

The next five species, and a new species described in a later section, form the *monstrosus* group. This group is discussed in general terms and the several species keyed out later.

***Batrisodes monstrosus* (LeConte)**

Diagnosis: *Male.* This is a large, shining, sparsely pubescent species. Antennae with segment VIII with lateral face slightly produced; IX flattened on ventral face; X with an oblique excavation on mesioventral face; XI simple, not spined at base.

Occiput-vertex with three carinae, a median longitudinal and a right and a left oblique. These three carinae tend to converge apically to form a subtriangular surface from base to center of occiput. The lateral oblique carinae are constant; there is a tendency for the median to vary from strong to short or interrupted. Vertexal foveae small but appearing large as each fovea occupies a depression. Eyes large, prominent, of about fifty facets. Face simple, declivous at an angle of about forty degrees, and not transversely impressed or excavated between antennal cavities.

Pronotum with the discal longitudinal carinae each represented by two or three recurved spines in apical half, and a prominent conical antebasal spine.

Elytra with three basal foveae on each elytron, the sutural fovea placed very near the suture; humeral angles each with a distinct tooth.

Last sternite long, medianly flattened and subglabrous.

Prothoracic legs with tibia deeply arcuate for basal half, with a small triangular cusp at base and a very prominent rounded triangular tooth at center of dorsal face; primary tarsal claw not bifid. Mesothoracic legs with femur bearing a deep, semicircular notch at apical four-fifths of dorsal face; tibia with a long arcuate, apically directed spine at apex of ventral face; tarsi normal. Metathoracic trochanter with a prominent arcuate, acute spine at apex; tibia with tibial spur absent; tarsi normal, compressed-cylindrical.

Female. As for male save that antennal segments IX, X and XI are not modified; median vertexal carina shows even a greater tendency to be short or absent; eyes rudimentary, small, composed of from six to twelve facets; all legs simple; last sternite shorter, not medianly flattened, pubescent.

DISTRIBUTION

Published Records: Athens, Clarke County, Georgia, Ohio and Pennsylvania (LeConte, 1850); Washington, District of Columbia (Schwarz, 1896); Northern States east of the Mississippi River (Brendel and Wickham, 1890); Cincinnati, Hamilton County, Ohio (Dury, 1903, 1908); throughout Indiana (Blatchley, 1910); Georgia, Pennsylvania, Ohio, Indiana (Leng, 1920); New York (Leonard, 1928); Pennsylvania to Indiana, south to Georgia (Bowman, 1934); Peoria, Illinois (Park, 1935).

Material Examined: DELAWARE (O.P.); DISTRICT OF COLUMBIA (O.P.); Clayton, Rabun County, GEORGIA at 2000-3700 feet (O.P.); Peoria, Peoria County, Springfield, Sangamon County, and Urbana, Champaign County, ILLINOIS (O.P.); Crothersville, Jackson County, INDIANA (O.P.); Silver Lake, Wyoming County and Staten Island, NEW YORK (O.P.); Harrisburg, Dauphin County, PENNSYLVANIA (O.P.).

Bowmanville, Cook County, ILLINOIS and Lake Forest, Lake County, ILLINOIS (CNHM); Tioga County, PENNSYLVANIA (CNHM); Staten Island, NEW YORK (CNHM).

ILLINOIS (INHS); Plummers Island, MARYLAND (INHS).

Type specimen from GEORGIA (MCZ type 6161); DISTRICT OF COLUMBIA (MCZ); Stelton, Middlesex County, NEW JERSEY; Fredericksburg, Spotsylvania County, VIRGINIA (MCZ).

Batrisodes ferox (LeConte)

This is placed as a variety of *monstrosus* by Leng (1920, p. 129). Varietal status is not warranted. The type (MCZ type 6162) is a female and does not show any unusual structural development within the range of variation of the *monstrosus* population.

DISTRIBUTION

Published Records: Ohio and Pennsylvania (LeConte, 1850); Northern States east of the Mississippi (Brendel and Wickham, 1890); Cincinnati, Hamilton County, Ohio (Dury, 1903, 1908); Pennsylvania, Ohio and Indiana (Leng, 1920); New York (Leonard, 1928).

Material Examined: Type (MCZ 6162).

Batrisodes cristatus (LeConte)

This is placed as a variety of *monstrosus* by Leng (1920, p. 129). Varietal status is not warranted. The type (MCZ type 6163) is an immature or callow female and does not show any unusual development of morphology within the range of variation of *monstrosus*.

DISTRIBUTION

Published Records: Pennsylvania (LeConte, 1850, and Leng, 1920).

Material Examined: Type (MCZ 6163).

Batrisodes armiger (LeConte)

Diagnosis: Male. This is a bizarre relative of *monstrosus*. It differs from the preceding diagnosis in the following structural features. Antennal segment IX is transverse, with ventral face shorter than dorsal face, and produced as a thin shelf; X with a larger, deeper excavation on ventral face; XI with a sinuate ventral face, and the basal fifth produced into a thick, oblique, prominent spine.

The third and fourth visible sternites have a brush of long, flavous, mesially recurved setae on the ventrolateral aspect.

The median tooth on the dorsal face of the prothoracic tibia is very high and slender, lanceolate.

The second tarsomere of the metathoracic legs is greatly swollen and ovate and as wide to wider than tibia (Pl. III, 4).

DISTRIBUTION

Published Records: Pennsylvania (LeConte, 1850); Allegheny Mountains, Pennsylvania (Brendel and Wickham, 1890); Pennsylvania (Leng, 1920); Allegheny Mountains (Bowman, 1934); Sunburst, North Carolina (Brimley, 1942).

Material Examined: Near Steinhatchee River, FLORIDA (O.P.).
Type specimen from PENNSYLVANIA (MCZ type 6160).

Batrisodes cavicrus (Casey)

Diagnosis: Male. Antennae simple. Head with prominent eyes and well developed lateral vertexal carinae. Occiput with three apically converging carinae: a median longitudinal carina, and a right and a left oblique carina. These three carinae strong; the median varying within the population from an undulated, entire ridge to an interrupted or serrate carina. An extreme of this latter condition is reached in which the median occipital carina ends between the vertexal foveae in an elevated, triangular tooth, and a detached tooth or spine arises from the

vertex anterior to the vertexal foveae. Vertexal foveae deep and nude; circumambient sulcus entire, greatly lengthened anteriorly, between the antennal tubercles, where the sulcus is involved with the facial declivity. Face declivous, not transversely excavated; front separated from clypeus by an angulated carina; clypeus simple.

Pronotum with a discal row of two acute, recurved teeth on each side of the median sulcoid impression. The interruption of the discal carinae into several isolated, recurved teeth may be viewed as a parallel to the similar tendency for the median occipital carina to become interrupted. These discal pronotal carinae are common features for many species of *Batrisodes,* but the *monstrosus* group generally has these carinae represented by these isolated teeth, and, finally, in *confinis,* these teeth disappear as well. In *cavicrus* the lateral pronotal margins are not spinose, in contrast to *sandersoni* and *carolinae.*

Each elytron with three nude basal foveae.

Fifth visible (last) sternite deeply concave medianly for apical three-fourths of length.

Prothoracic legs with unmodified tibia, and with primary tarsal claw not bifid.

Mesothoracic legs with femur unmodified, and tarsi normal.

Metathoracic legs abnormal. Trochanter with a sinuate spine at apex. Femur with dorsoventral diameter increased, anterior face pubescent and convex, posterior face glabrous and concave, to produce a median concave area, the ventral margin of which is abruptly sinuate at basal third.

Female as for male except that the eyes are rudimentary, the last sternite is convex save for a slight semicircular depression in basal half, and the metathoracic legs are unmodified.

DISTRIBUTION

Published Records: Asheville, Buncombe County, North Carolina (Casey, 1893); Crawford County, Indiana and Cincinnati, Hamilton County, Ohio (Blatchley, 1910); North Carolina and Indiana (Leng, 1920); Asheville, Buncombe County, North Carolina (Bowman, 1934); North Carolina (Brimley, 1938).

Material Examined: Type specimens, from Asheville, Buncombe County, NORTH CAROLINA (USNM); Sassafras Mountains, SOUTH CAROLINA (INHS).

***Batrisodes confinis* (LeConte)**

In the original description of this species LeConte (1850, p. 96) stated that it was based on a single female specimen, and this mistake has remained *perdu* these many years, and probably was a contributing cause for a synonym noted later. I have examined the type of *confinis* (MCZ type 6159) and find it to be a male, with large prominent eyes of more than forty facets, and the posterior trochanters each armed with a hooked spine at the apex of the ventral face. The species is typical

of the *monstrosus* group in the absence of spurs on the posterior tibiae, and LeConte probably thought that his specimen was a female since it lacked the modifications of the antennae, anterior tibiae, and intermediate femora so typical of males of *monstrosus* and *armiger*.

Diagnosis. Male. Antennae simple. Head with a long median vertexal carina that bisects cervicum, cervical sulcus, occiput and ends on a line through the posterior eye margins; lateral vertexal carinae absent; eyes prominent, as normal for males of the *monstrosus* group; vertexal foveae deep, nude, on a line posterior to the eyes; deep circumambient sulcus entire, its apical margin medianly angulated; face not transversely excavated or impressed between antennal cavities, the frontoclypeus bearing a Y-shaped carina; this carina has an arm extending obliquely to a point near the base of the first antennal segment, and the two oblique arms unite medianly to form a single carina that extends nearly to the apical margin of clypeus.

Pronotum with discal lateral carinae absent, and lacking also the recurved teeth that represent these carinae in *cavicrus* and *carolinae*.

Each elytron with apparently two, but in reality three, basal foveae (Pl. V, 5), the sutural fovea being deeply recessed beneath the sutural margin.

Last (fifth visible) sternite bearing a conspicuous, semicircular depression in basal two-thirds, the straight basal edge of this depression being parallel with the apical margin of the fourth visible sternite.

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic legs with tibia bearing a strong spine at apex of ventral face, and tarsi normal (Pl. V, 6).

Metathoracic legs with trochanter bearing a strong, arcuate spine at apex of ventral face; tibia not bearing an apical spur.

DISTRIBUTION

Published Records: Athens, Clarke County, Georgia (LeConte, 1850); Cincinnati, Hamilton County, Ohio (Dury, 1903, 1908); Putnam County, Indiana (Blatchley, 1910); Georgia, Indiana (Leng, 1920); Georgia and Putnam County, Indiana (Bowman, 1934); Raleigh, Wake County, North Carolina (Brimley, 1942).

Material Examined: Type from GEORGIA (MCZ 6159).

Batrisodes curvatus Sanderson

This is a synonym of *confinis* (LeConte). I have studied the types of *confinis* and of *curvatus* and find them identical. It is wholly understandable how the synonym was formed in view of the mistaken sex of *confinis* and its obscurity over the past century.

In the original description of *curvatus*, the posterior tibiae are stated to have apical spurs. This was probably a typographical error, as the type specimen does not have such spurs.

DISTRIBUTION

Published Records: Clemson, Oconee County, South Carolina (Sanderson, 1940).

Material Examined: Holotype male, from the above locality (INHS).

Batrisodes carolinae (Casey)

This species is known only from the male sex. It is readily separated from its allies by the following combination of features. (1) The occiput has the median longitudinal carina well formed, but lacks the right and left oblique occipital carinae. (2) The pronotum has the discal carinae represented by two series of longitudinally recurved spines, as in *cavicrus.* (3) Each lateral pronotal margin bears a posteriorly-directed spine, as in *sandersoni.* (4) The anterior legs are simple, as in *cavicrus.*

DISTRIBUTION

Published Records: Asheville, Buncombe County, North Carolina (Casey, 1893); North Carolina (Leng, 1920); Asheville, Buncombe County, North Carolina (Bowman, 1934); North Carolina (Brimley, 1938).

Batrisodes schaumi (Aubé)

Diagnosis: Male. Antennae with segment VII with the ventroapical face produced into a gradually formed, triangular tooth at right angles to long axis of segment; XI with an apically arcuate spine at basal margin of ventral face.

Occiput-vertex rather tumid, median vertexal carina variable from present over vertex and occiput to absent on vertex but present as a bisector of the cervicum and cervical sulcus; lateral vertexal carinae sharp and well developed; vertexal foveae deep and nude; antennal incisures deep and pubescent; eyes large and prominent. Face greatly narrowed between antennal cavities, declivous between antennae at an angle of about forty-five degrees, simple, not transversely impressed or excavated between antennal cavities.

Each elytron with three basal foveae.

Prothoracic legs with primary tarsal claw not bifid. Mesothoracic legs with femur bearing a long, arcuate, very blunt spine at basal third of ventral face; tibia with a long, oblique spine on posterior face at apical four-fifths, partially obscured by a brush of setae; tarsi normal. Metathoracic legs with tibia bearing a long apical spur. First sternite medianly longitudinally carinoid.

Female. Unique in the area under study by having abnormal antennae, segment VII as in the male save that the triangular tooth is variable in size, at times as well-formed as some males, in other specimens only slightly produced; XI not spined at base. Face as in male save that it is less narrowed between antennal cavities, Legs simple, lacking the

male modifications. Sutural and discal basal elytral foveae close together, and very rarely the discal fovea is obsolete. First visible sternite relatively normal, not bearing a long, strong median longitudinal carina.

DISTRIBUTION

Published Records: Pennsylvania and Illinois (Brendel and Wickham, 1890; Leng, 1920; Bowman, 1934); New York (Leng and Nicolay, in Leonard, 1928); Palos Park, Cook County, Illinois (Park, 1935).

Material Examined: Palos Park, Cook County, ILLINOIS (O.P.); Warrens Woods, Lakeside, Berrien County, MICHIGAN (O.P.); Fort Lee, Bergen County, NEW JERSEY (O.P.); Central Park, New York, NEW YORK (O.P.); St. Vincent, PENNSYLVANIA (O.P.).

Magnolia, Putnam County, ILLINOIS (INHS).

St. Vincent, Westmoreland County, PENNSYLVANIA (MCZ); Fredericksburg, Spotsylvania County, VIRGINIA (MCZ).

Batrisodes punctatus (LeConte)

As noted by Leng (1920, p. 129), this is a synonym of *schaumi*. The type of *punctatus* (MCZ 6167) is a female, and both this and the males in LeConte's series agree perfectly with *schaumi*.

DISTRIBUTION

Published Records: Athens, Clarke County and (?) Nacoochee ("Nakutshique"), White County, Georgia (LeConte, 1850); Georgia (Leng, 1920).

***Batrisodes riparius* (Say)**

Diagnosis: Male. Antennae with segment IX very transverse, the lateral face produced as a thin, setigerous platform, so that the segment is two to four times wider than long, often in a width to length ratio of 15 to 7; X with a very deep fovea covering almost all of ventral face; XI sinuate, with a large conical spine at basal margin of ventral face (Pl. II, 2).

Median vertexal carina and lateral vertexal carinae well developed; vertexal foveae deep and nude; eyes large and prominent. Face with the front declivous between the antennae, granulate-punctate, transversely excavated between antennal cavities, the overhanging frontal margin medianly arcuate-rounded and setigerous.

Each elytron with three basal foveae.

Prothoracic legs with primary tarsal claw not bifid. Mesothoracic legs with tarsi abnormal, the second tarsomere compressed, slightly arcuate, and with the ventral face deeply notched at center. Metathoracic legs with tibia bearing a long apical spur.

DISTRIBUTION

Published Records: Georgia and Pennsylvania (LeConte, 1850); Country along the Ohio River (Brendel and Wickham, 1890); Cincinnati, Hamilton County, Ohio (Dury, 1903, 1908); Posey County, Indiana (Blatchley, 1910); Missouri, Georgia, Pennsylvania (Leng, 1920); New York (Leonard, 1928); Pennsylvania, to Georgia and west to Missouri (Bowman, 1934); Palos Park, Cook County, Illinois (Park, 1935).

Material Examined: Urbana, Champaign County and Palos Park, Cook County, ILLINOIS (O.P.); Staten Island, NEW YORK (O.P.); St. Vincent, PENNSYLVANIA (O.P.).

Fox Ridge State Park, ILLINOIS (INHS).

ILLINOIS (MCZ); St. Vincent, Westmoreland County, PENNSYLVANIA (MCZ).

Batrisodes uncicornis Casey

Diagnosis: Male. This species is closely allied to, but quite distinct from, *riparius*. The antennae have segment IX only a little wider than long, commonly in a width to length ratio of 9 to 7, and the segment consequently lacks the thin external shelf (Pl. II, 1); X with a deep excavation on ventral face; XI with an oblique spine from basal margin of sinuate ventral face.

Head similar to *riparius* except that the frontal declivity is not as abrupt, and the overhanging frontal margin is less rounded and more pointed medianly over the deep transverse excavation between the antennal cavities.

Elytra with three basal foveae on each elytron.

Prothoracic legs with primary tarsal claw not bifid. Mesothoracic legs with abnormal tarsi, but the degree of abnormality much less than in *riparius*, the ventral face of the second tarsomere less abruptly arcuate in basal half. Metathoracic legs with a long tibial spur.

DISTRIBUTION

Published Records: New York City, New York (Casey, 1897); New Jersey and New York (Leng, 1920); New York (Leonard, 1928); New York City and vicinity (Bowman, 1934); Raleigh, Wake County, North Carolina (Brimley, 1942); Mobile and Baldwin Counties, Alabama (Löding, 1945).

Material Examined: Palisades, Bergen County, NEW JERSEY (O.P.); Central Park, New York, NEW YORK (O.P.). Type specimen from New York examined November 12, 1941 (USNM).

Raleigh, Wake County, NORTH CAROLINA (INHS).

Batrisodes juvencus (Brendel)

This species is unknown to me. It may be a synonym of *riparius* (Say). It was not listed in the Leng "Catalogue" (1920), and, according to Bowman (1934, p. 65), has not been recognized.

The only published record of its distribution is that of Brendel, who stated that the species was described on a specimen taken by him in "Northern Illinois," while describing the species (Brendel, 1865, p. 258). Later (Brendel, 1866, p. 36) it was stated that the type specimen was a female.

Batrisodes scabriceps (LeConte)

Diagnosis: Male. Antennae with segment I with mesial face strongly granulated, in contrast to shining remainder of antenna; segment X as wide as XI and bearing a large fovea on ventral face (Pl. II, 13).

Head (Pl. VI, 8) with long, strong median and lateral vertexal carinae; vertexal foveae deep and nude, each fovea at base of a deep, glabrous, slightly arcuate foveal impression, these impressions not uniting apically; eyes prominent, and composed of relatively large facets; dorsal surface of head very coarsely scabropunctate. Front narrowed between antennal articulations, then abruptly and vertically declivous. This frontal declivity semicircularly excavated (Pl. VII, 3) in median half of width, the complex excavation glabrous, with carinoid lateral walls, and bearing two pairs of conical tubercles, a median pair that is basally contiguous and projects anteriorly from the base of the frontal margin, and a lateral pair in which one tubercle is placed above and lateral of each median tubercle. The front deeply and transversely excavated, between antennal cavities, beneath this complex overhanging frontal margin.

Each elytron trifoveate.

Last (fifth visible) sternite medianly concave and laterally tuberculate, as in *furcatus*.

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic legs with normal, simple tarsi.

Metathoracic legs with tibia bearing a stout apical spur.

DISTRIBUTION

Published Records: Pennsylvania, Illinois and Iowa (Brendel and Wickham, 1890); Iowa City, Johnson County, Iowa (Wickham, 1896); New Jersey, Pennsylvania, Illinois and Iowa (Leng, 1920); New York (Leonard, 1928); New Jersey to Iowa (Bowman, 1934); Warrens Woods, Lakeside, Berrien County, Michigan (Park, 1935).

Material Examined: Type specimen (MCZ 6166); St. Vincent, Westmoreland County, PENNSYLVANIA (MCZ).

Brownfield Woods, Urbana, Champaign County, ILLINOIS (O.P.); Warrens Woods, Lakeside, Berrien County, MICHIGAN (O.P.); Cambria County, PENNSYLVANIA (O.P.).

St. Vincent, Westmoreland County, PENNSYLVANIA (CNHM).

Washington County, ARKANSAS (INHS); Platte City, Platte County, MISSOURI (INHS).

Batrisodes harringtoni Casey

This is a synonym of *scabriceps* (LeConte).

DISTRIBUTION

Published Records: Ottawa, Canada; Bayfield, Bayfield County, Wisconsin and Westmoreland County, Pennsylvania (Casey, 1897 and Bowman, 1934); Canada, Wisconsin and Pennsylvania (Leng, 1920); Raleigh, Wake County, North Carolina (Brimley, 1942).

Material Examined: Types from type localities cited above (USNM).

Batrisodes temporalis Casey

Diagnosis: Male. This well-marked species is a member of the *scabriceps* group. The antennae are simple, with segment X relatively small for *Batrisodes* males, and not foveate or excavated on its ventral face (Pl. VII, 1).

Head trapezoidal, with long subparallel tempora longer than the prominent eyes; vertex with well-developed lateral vertexal carinae. The median vertexal carina is diagnostic, extending from occiput anteriorly where it bisects the entire vertex and continues over the front into the frontal declivity. This is the longest median vertexal carina known to the author. Frontal declivity in general as described for *scabriceps,* save that the limits of the glabrous, semicircular excavation are not sharply defined in *temporalis* and the two pairs of conical tubercles in this glabrous field are oriented differently. These points between *scabriceps* and *temporalis* are illustrated for comparison (Pl. VII, 2, 3). Vertexal foveae deep and nude; circumambient sulcus incomplete and replaced by a deep, oblique sulcus extending anteriorly from each vertexal fovea; front, save for median glabrous area on declivity, and the anterior part of the vertex, scabropunctate; posterior part of vertex sparsely granulate; front excavated between the antennal cavities, beneath the overhanging frontal margin.

Median, longitudinal pronotal sulcus very long, extending almost to the apical pronotal margin.

Each elytron with three deep, nude basal foveae.

Fifth sternite as in *scabriceps* and *furcatus.*

Aedeagus long and slender (Pl. VII, 4).

Prothoracic legs with the tarsi relatively very short and thick for *Batrisodes,* the tarsal claw very long and obliquely angulate.

Mesothoracic legs with normal tarsi.

Metathoracic legs with tibia bearing an apical spur.

DISTRIBUTION

Published Records: Westmoreland County, Pennsylvania (Casey, 1897; Bowman, 1934); Pennsylvania (Leng, 1920)

Material Examined: Type specimen from above locality (USNM).
St. Vincent, Westmoreland County, PENNSYLVANIA (MCZ).

Batrisodes frontalis (LeConte)

Diagnosis: Male. This is a large species with glistening integuments and sparse, subappressed, bright, flavous setae; the setae on the maxillary palpi and those of the genal beard are bristling and conspicuous. The antennae are long, simple, unmodified save for segment I. This latter

segment has the ventral face pinched into a ventrally dilated, oblique pyramidal process.

The long head has the median vertexal carina bisecting the cervicum, deep cervical sulcus and occiput, to end on the elevated posterior portion of the vertex; the lateral vertexal carinae are well-developed on the posterior portion of the vertex; the vertexal foveae are deep and nude, on a line through the posterior eye-margins; these foveae are connected by a very long circumambient sulcus that occupies the anterior half of the vertex. The eyes are prominent. The antennal incisures are deep and complex. The front is elevated on the top of the head between the antennal insertions, and then becomes declivous, so that the frontal declivity formed extends well anteriad of the antennal bases, and may reach medianly to the anterior margins of the anteriorly-directed first antennomeres. This gives a broadly-rounded frontal arc, when seen from above, similar to that of *globosus, beyeri,* and some other species. The ventral margin of this frontal declivity is strongly biarcuate, and overhangs the deep frontal excavation that extends between the antennal cavities. This facial excavation is bounded ventrally by a long, anteriorly-directed, laterally densely setose process of the clypeus.

Each elytron has three deep, nude basal foveae.

The last sternite is medianly flattened and laterally tuberculate.

The prothoracic legs have inflated femora; the second tarsomere has a spur of semi-agglutinated setae that diverge obliquely from the apex of its lateral face; the primary tarsal claw is apically blunt and bifid (Pl. III, 11). The mesothoracic legs have normal tarsi. The metathoracic legs have the tibia bearing an apical spur.

DISTRIBUTION

Published Records: [9] Pennsylvania (LeConte, 1850); between the thirty-sixth parallel and the (Great) lakes (Brendel and Wickham, 1890); Colorado Springs, El Paso County, Colorado (Wickham, 1898); Iowa City, Johnson County, Iowa (Wickham, 1900); Cincinnati, Hamilton County, Ohio (Dury, 1903, 1908); Pennsylvania, Missouri and Wisconsin (Casey, 1908); Pennsylvania, Missouri and Wisconsin (Leng, 1920); Pennsylvania to Missouri and northward (Bowman, 1934); White Heath, Piatt County, Illinois (Park, 1935).

Material Examined. [9] Glenview, Cook County, ILLINOIS (CNHM); Iowa City, Johnson County, IOWA (CNHM); Buena Vista, Chaffee County and Colorado Springs, El Paso County, COLORADO (CNHM); Springfield, Sangamon County and Brownfield Woods, Urbana, Champaign County, ILLINOIS (O.P.); PENNSYLVANIA (O.P.); Rochester, Olmsted County, MINNESOTA (O.P.).

ILLINOIS (INHS); Baldwin City, Douglas County, KANSAS (INHS).

Type specimen from PENNSYLVANIA (MCZ 6165); IOWA (MCZ); Aweme, MANITOBA, CANADA (MCZ).

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[9] The Colorado records of *Batrisodes frontalis* and *B. globosus* are of such interest that they form the substance of a later section of this article.

The next five species form the *lineaticollis* group. This assemblage is easily distinguished as a group, but the several species that compose it are separated with difficulty and a considerable amount of confusion in identification has further complicated the taxonomy.

This group consists of: *lineaticollis* (Aubé), *bistriatus* (LeConte), *fossicauda* Casey, *declivis* Casey, and *cartwrighti* Sanderson.

All of them have the same sure yet almost indefinable habitus of close relationship. Notable features of this habitus are the prominent, relatively finely faceted eyes; the broad head that is conspicuously granulate-punctate; the simple face that is lengthily declivous; the front that is neither transversely impressed nor excavated between the antennal cavities; the male sex with the tenth antennal segment foveate on the ventral face and with the last sternite bearing a distinct median impression.

Batrisodes lineaticollis (Aubé)

Diagnosis: Male. The antennae are simple and unmodified, with the exception of segment X, which is relatively large and bears a large, deep fovea on its ventral face.

The head has the median vertexal carina and lateral vertexal carinae well developed; vertexal foveae deep and nude; eyes large and prominent Vertex slightly declivous at an angle of about twenty degrees from center, on a line through eye-centers, to a point on a line between antennal articulations; from this latter point, the front becomes suddenly more declivous, at an angle of about forty-five degrees, and this fronto-clypeal declivity continues uninterrupted to the anterior clypeal margin. Consequently the face is neither transversely impressed nor excavated between the antennal cavities (Pl. I, 3), although there are two vague longitudinal, ovate impressions on frontal declivity between the antennae. The *entire* dorsal surface of the head is rather roughly sculptured, this sculpture becoming especially obvious on the face in the form of coarse punctures and granular denticles (Pl. VII, 6).

The median longitudinal sulcus of the pronotum is long, having a length, in relation to the total pronotal length, of 5 to 7 respectively. On the other hand, the sulcus is not "entire," and does not reach the apical pronotal margin as suggested in the original figure of Aubé (1833, Pl. 90, fig. 3).

Each elytron with three basal foveae.

Last sternite bearing a median depression that is oval and slightly longer than wide, as illustrated (Pl. V, 1).

Prothoracic legs with the primary tarsal claw not bifid. Mesothoracic legs with normal tarsi. Metathoracic legs with apical tibial spurs.

Female. As for male save that antennal segment X is normally small and not foveate on its ventral face; last sternite much shorter and lacks a median depression.

DISTRIBUTION

Published Records: America Septentrionali (Aubé, 1833); Georgia and Pennsylvania (LeConte, 1850); Pennsylvania (Brendel and Wickham, 1890); Iowa City, Johnson County, Iowa (Wickham, 1894); Cincinnati, Hamilton County, Ohio (Blatchley, 1910, p. 326); Pennsylvania and Georgia (Leng, 1920); New York (Leonard, 1928); Pennsylvania and Georgia (Bowman, 1934).

Material Examined: South Orange, Essex County and Newfoundland, Morris County, NEW JERSEY (O.P.); Amagansett, Suffolk County, Long Island, NEW YORK (O.P.).

NEW JERSEY (MCZ).

As noted above, the published range covers almost the entire area under study, and all of the ranges of the five species that make up the group. Actually, *lineaticollis sensu strictiore* would appear to be limited in its distribution, on the basis of material seen, and it probably does not occur outside of the northeastern section.

Batrisodes bistriatus (LeConte)

This species is closely allied to *lineaticollis,* and the diagnosis of the latter may be used for *bistriatus* except for two critical features: (1) the area of the head bounded by the circumambient sulcus anteriorly, and laterally by the vertexal foveae is subimpunctate in *bistriatus,* in sharp contrast to the coarsely punctate-scabroid integument external to this area; whereas in *lineaticollis* the entire dorsal surface of the head is punctate-granulate. (2) The median longitudinal sulcus of the pronotum is obsolete in *bistriatus,* not reaching the center of the disc; whereas in *lineaticollis* it extends over the disc.

DISTRIBUTION

Published Records: Pennsylvania (LeConte, 1850; Brendel and Wickham, 1890; Leng, 1920; Bowman, 1934).

Material Examined: PENNSYLVANIA (MCZ type 6172); Cornwall, Litchfield County, CONNECTICUT (MCZ).

This species also appears to be restricted in its range, from Pennsylvania northward into New England.

Batrisodes cartwrighti Sanderson

This species is allied closely to *lineaticollis.*

Diagnosis: Male. Median vertexal carina present but obscured by the granules of the integument; lateral vertexal carinae fine, arcuate, entire; eyes prominent; vertexal foveae deep and nude, on a line through the posterior margins of the eyes; whole dorsal surface of head roughly sculptured,

granulate on occiput and vertex between the foveae, becoming very coarsely punctate on the face. From a lateral view, the vertex is convex, and the frontoclypeus is rather abruptly declivous at an angle of about forty-five degrees to near the apical clypeal margin, where the surface flattens out. Head slightly wider through the eyes than the pronotum, in a ratio of about 7.8 to 7. Antennae (Pl. V, 4) as in *lineaticollis.*

Median pronotal sulcus as in *lineaticollis;* that is, about four-fifths the pronotal length.

Each elytron with three distinct, deep, nude basal foveae.

Last (fifth visible) sternite (Pl. V, 2) diagnostic. The median excavation having subparallel, minutely serrulated sides, the apical end closed, the basal end open as a narrow sinus on each side of an arcuate, raised and glabrous basal tumulus. This depression in *lineaticollis* and *bistriatus* (Pl. V, 1) is also longer than wide, but is subacute-oval in outline, and both apical and basal acute ends are closed.

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic legs with normal tarsi, and the tibia bearing an apical spine on ventral face.

Metathoracic legs with tibia bearing an apical spur.

DISTRIBUTION

Published Records: Clemson, Oconee County, South Carolina (Sanderson, 1940).

Material Examined: Holotype male, from above locality (INHS).

Batrisodes fossicauda Casey

After Casey (1897, p. 574) had described this species it was placed as a doubtful synonym of *bistriatus* (LeConte) by Raffray (1908, p. 159). Casey (1908, p. 262) refuted this synonomy and stated in what particulars these two species differed. Leng (1920, p. 129) again placed *fossicauda* as a questionable synonym of *bistriatus.* Bowman (1934, p. 68) again established *fossicauda,* remarking "From the descriptions, the present species (*fossicauda*) seems to be distinct, and it seems best to retain it until the matter is settled."

I have studied the types of *fossicauda* at the U. S. National Museum, especially paratype 38669, and agree with Casey and Bowman that *fossicauda* is a distinct species. Actually, it is more closely related to *lineaticollis.*

Diagnosis: Male. In general very similar to *lineaticollis,* but separable on two critical features: (1) The roughly punctured head of *fossicauda* has the declivity starting at a point between the eyes on the center of the vertex, and continuing apicoventrally to the apical clypeal margin at an even angle of about twenty degrees; whereas in *lineaticollis, bistriatus* and *cartwrighti* the declivity is in two steps (Pl. I, 3), the roughly

punctured head having the vertex slightly declivous to a line passing through the antennal tubercles at about twenty degrees, then the front becomes much more strongly declivous at an angle of about forty-five degrees. (2) The last sternite of *fossicauda* has a weakly defined, shallow depression that is transversely oval (Pl. V, 3); whereas in *lineaticollis, bistriatus* and *cartwrighti* (Pl. V, 1, 2) the depression is deeper, and longer than wide

DISTRIBUTION

Published Records: Westmoreland County, Pennsylvania (Casey, 1897); Iowa City, Johnson County, Iowa (Wickham, 1900); Pennsylvania and Connecticut (Leng, 1920); Westmoreland County, Pennsylvania (Bowman, 1934).

Material Fxamined: PENNSYLVANIA (O.P.); type and paratypes, Westmoreland County, PENNSYLVANIA (USNM); PENNSYLVANIA (MCZ).

The published records report this species as far north as Connecticut and as far west as Iowa. This is undoubtedly the result of confusion of this species with others in the group. At present the limited material suggests a more restricted range.

Batrisodes declivis Casey

Diagnosis: Male. This species is closely allied to *fossicauda,* in both the long, even facial declivity and the weakly formed, transversely oval depression of the last sternite.

The species may be separated from *fossicauda* on two features: (1) The head in *declivis* is distinctly wider through the eyes than the pronotum, whereas the head and pronotum are subequal in width in *fossicauda.* (2) The fovea of the ventral face of antennal segment X is smaller, covering the basal half of the area, in *declivis,* whereas this fovea covers the basal three-fourths of the ventral face in *fossicauda.*

DISTRIBUTION

Published Records: Iowa City, Johnson County, Iowa (Casey, 1908; Bowman, 1934); Iowa (Leng, 1920).

Material Examined: Iowa City, Johnson County, IOWA (CNHM), (MCZ).

This would appear to be a population occupying the western portion of the deciduous forest formation. It is possible that *declivis, fossicauda, cartwrighti,* and *bistriatus* are variations of *lineaticollis* but in the absence of long series of each, covering all of the territory occupied by the group, no basis exists for such an assumption. On the limited material available, these five populations appear to be distinct species. Direct genetical experiments and palaeontological data are lacking.

Batrisodes antennatus Schaeffer

Diagnosis: Male. This is a very shining, blackish brown species with contrasting, sparse, flavous pubescence and light brown appendages. The antennae have segments I to VIII simple and unmodified, but the

club is very abnormal (Pl. II, 9) as follows: segment IX transverse, with the ventral face produced obliquely into a long, pyramidal spine; X transverse, with the ventral face very irregularly flattened and excavated; XI exceptionally large for the genus, with the flattened ventral face bearing a broad, shallow, oval concavity on the ventral half..

Head lacks a median vertexal carina, but the lateral vertexal carinae are long and entire, from antennal incisures to temporal angles; vertexal foveae deep and nude. Face with the front declivous from a line through antennal articulations, at an angle of about thirty degrees. This frontal declivity narrows rapidly, and terminates on a line passing through eye centers, when the head is examined from a direct anterior view; the frontal declivity is rounded-triangular in outline, and covered with very minute flavous setae. This declivity is separated abruptly from the clypeus by a deep, narrow transverse excavation between the antennal cavities.

Each elytron with three nude, deep, basal foveae.

Fifth (last visible) sternite is short and unmodified and convex.

Prothoracic legs with primary tarsal claw not apically bifid. Mesothoraric legs with abnormal tarsi, the second tarsomere is medianly strongly notched on its ventral face. Metathoracic legs with the tibia bearing a thick apical spur.

Female. As for male, except that the antennal club is perfectly simple; the face evenly declivous at an angle of about thirty degrees, and is not transversely impressed or excavated, the dorsal surface of the head is strongly shining and subglabrous, but the apical three-fourths of the facial declivity is granulate-punctate; mesothoracic tarsi simple and normal.

DISTRIBUTION

Published Records: Black Mountain, Buncombe County, North Carolina (Schaeffer, 1906); North Carolina (Leng, 1920); Black Mountain, Buncombe County, North Carolina (Bowman, 1934); North Carolina (Brimley, 1938).

Material Examined: Male and female paratypes, Black Mountain, Buncombe County, NORTH CAROLINA (O.P.); Hamrick, Yancey County, South Toe River Valley, NORTH CAROLINA (O P).

Batrisodes beyeri Schaeffer

Diagnosis: Male. Antennae with segment X wider than XI, and its ventral face bearing a small, circular fovea in basal fifth.

Head with median vertexal carina present but of variable length and strength; lateral vertexal carinae present from antennal incisures to temporal angles, but not easily discerned; vertexal foveae deep and nude. Front gently declivous and rapidly narrowed from antennal articulations to a point passing through anterior third of anteriorly directed basal antennal segments, then front abruptly and vertically declivous and

medianly carinoid to the overhanging frontal margin; frontal margin blackened and medianly produced in a thin, dark, triangular plate; this plate medianly sulcate and turned abruptly ventral at apex, so that the plate *appears* to consist of two right-triangular, contiguous teeth. Face below the overhanging frontal margin deeply, transversely excavated between antennal cavities. The medianly erected clypeus and the frontal plate fringed with a spray of long flavous setae.

Elytra with three deep, nude basal foveae on each elytron.

Last visible (fifth) sternite simply convex.

Prothoracic legs with primary tarsal claw not apically bifid, but under a 10 X objective is seen to be apically, obliquely grooved as though the bifidation were either incipient or vestigial.

Mesothoracic legs with normal, simple tarsi.

Metathoracic legs with tibia bearing a stout apical spur.

Female. As for male except that antennal segment X is normally smaller and unmodified, and the face is evenly declivous and not transversely excavated.

This species is allied to *globosus,* and may be a specialized montane species of the *globosus* group, restricted to the southern Appalachian mountains.

DISTRIBUTION

Published Records: Black Mountain, Buncombe County, North Carolina (Schaeffer, 1906); North Carolina (Leng, 1920); Black Mountain, Buncombe County, North Carolina (Bowman, 1934); North Carolina (Brimley, 1938).

Material Examined: Male and female paratypes, Black Mountain, Buncombe County, NORTH CAROLINA (O.P.); Hamrick, Yancey County, South Toe River Valley, NORTH CAROLINA (O.P.).

Batrisodes globosus (LeConte)

This is the best known, most abundant, and most widely distributed species of the genus in the Western Hemisphere.

Diagnosis: Male. Antennae with segment X distinctly wider than XI and bearing a small, circular fovea at basal five-sixths of ventral face (Pl. II, 4).

Head (Pl. I, 1; IV, 1) with long, strong median and lateral vertexal carinae; vertexal foveae deep and nude, connected by an entire circumambient sulcus; head coarsely punctate external to this sulcus and the enclosed space of vertex lightly punctulate; antennal incisures well developed; eyes prominent. Front gradually narrowed and extended between antennal articulations as a long arc, as in *frontalis,* the surface gradually declivous, with the apex of this frontal arc on a line between the apical thirds of the anteriorly-directed basal antennomeres. This frontal arc, from a direct facial view, is medianly continued ventroposteriorly as a median carinoid ridge, and laterally, between this median ridge and

each basal antennomere, the frontal margin is continued ventroposteriorly in a strong, cuneiform ridge. Face deeply and transversely excavated beneath this overhanging frontal margin, between the antennal cavities. Clypeus medianly bearing a setose, apically-directed tubercle.

Each elytron trifoveate at base.

Last (fifth visible) sternite simple.

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic legs with tibia bearing a strong apical spur, and with simple, normal tarsi (Pl. III, 5)

Metathoracic legs with tibia bearing a relatively small, acute apical spur (Pl. III, 2).

Female. As for male, except that antennomere X is normally smaller than XI and not ventrally foveate; face evenly declivous and consequently not transversely impressed or excavated.

DISTRIBUTION

Published Records:[9] Georgia and Pennsylvania (LeConte, 1850); East of the Mississippi River (Brendel and Wickham, 1890); Colorado Springs, El Paso County, Colorado (Wickham, 1898); Iowa City, Johnson County, Iowa (Wickham, 1900); Cincinnati, Hamilton County, Ohio (Dury, 1903, 1908); throughout Indiana (Blatchley, 1910); Connecticut, Vermont, Florida, Indiana (Leng, 1920); New York (Leonard, 1928); Palos Park, Cook County, Illinois (Holmquist, 1928); Carlson Woods, near Razorback Lake, Sayner, Vilas County, Wisconsin (Park, 1932); Palos Park, Cook County, Illinois (Park, 1929); Eastern States (Bowman, 1934); Palos Park, Cook County, Illinois (Park, 1935a); Peoria, Peoria County, and White Heath, Piatt County, Illinois and Greenwood, Johnson County, Indiana (Park, 1935b).

Material Examined:[9] Spring Valley, Bureau County; Urbana, Champaign County, Chicago, Des Plaines and Palos Park, Cook County; Wheaton, DuPage County; Yorkville, Kendall County; Volo, Lake County; Algonquin, McHenry County; Peoria, Peoria County; White Heath, Piatt County; Putnam, Putnam County; Oakwood, Vermilion County; Enfield, White County; Rockford, Winnebago County, ILLINOIS (O.P.). Crothersville, Jackson County; Greenwood, Johnson County; Davis Woods at Smith, Laporte County; Gloyeski Woods at Chesterton, mesophytic pockets at Ogden Dunes, and Indiana Dunes State Park at Tremont, Porter County, INDIANA (O.P,). Elizabethtown, Hardin County and Mammoth Cave National Park, Edmonson, KENTUCKY (O.P.). Vowells Mill, Natchitoches Parish, LOUISIANA (O.P.). Warrens Woods at Lakeside, Berrien County, MICHIGAN (O P.). Fairview, Bergen County and South Orange, Essex County, NEW JERSEY (O.P.). Massapequa, Nassau County, NEW YORK (O.P.). OHIO (O.P.). Enola, Cumberland County, PENNSYLVANIA (O.P.). TENNESSEE (O.P.). Cambridge and Madison, Dane County and Sayner, Vilas County, WISCONSIN (O.P.).

Midland County, MICHIGAN (R. R. Dreisbach).

Boulder, Boulder County, COLORADO (U. Colo. Mus.)

Hemmingford and Fort Coulonge, QUEBEC, CANADA (CNHM); Colorado Springs, El Paso County, COLORADO (CNHM); Bowmanville, Chicago, Glenview, South Chicago, Tiedtville and Willow Springs, Cook County, and Antioch, Lake County, ILLINOIS (CNHM); INDIANA (CNHM); Iowa City, Johnson County, IOWA (CNHM); Marion, Plymouth County, MASSACHUSETTS (CNHM);

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[9] See page 76.

St. Clair County, MISSOURI (CNHM); Cincinnati, Hamilton County, OHIO (CNHM); Nashville, Davidson County, TENNESSEE (CNHM); Reading, Berks County, PENNSYLVANIA (CNHM); Fredericksburg, Spotsylvania County, VIRGINIA (CNHM); WISCONSIN (CNHM).

Washington County, ARKANSAS (INHS); Quincy, Adams County, Mayview and Urbana, Champaign County, Palos Park, Cook County, LaSalle County, Mount Olive, Macoupin County, Alhambra, Madison County, Havana, Mason County, and Magnolia, Putnam County, ILLINOIS (INHS); Lawrence, Douglas County and Elk City, Montgomery County, KANSAS (INHS); Cheboygan County, MICHIGAN (INHS); Raleigh, Wake County, NORTH CAROLINA (INHS).

ILLINOIS (MCZ); INDIANA (MCZ); KENTUCKY (MCZ); Chatham, Barnstable County, Framingham and Lowell, Middlesex County, and Sharon, Norfolk County, MASSACHUSETTS; Marquette, Marquette County and Ann Arbor, Washtenaw County, MICHIGAN; Montclair, Essex County, NEW JERSEY; PENNSYLVANIA (MCZ type 6168); TEXAS (MCZ); Fredericksburg, Spotsylvania, VIRGINIA (MCZ).

Batrisodes spretus (LeConte)

Diagnosis: Male. Antennae with segment I elongate, ventral face twice as long as wide, longer than II and III united, mesial face subgranular; X subspherical, slightly wider than XI, with a small, perforate fovea at basal fifth of ventral face as in *globosus* (Pl. VI, 7).

Eyes moderately prominent; vertexal foveae nude; circumambient sulcus subangulated, the apical portion apparently opening into the oblique sulci of the frontal declivity; front declivous between antennal tubercles, bearing two oblique, poorly defined, setose sulci that arise medianly with or near the circumambient sulcus and extend to the frontal margin; frontal margin medianly produced into a pair of blunted, setose, conoidal tubercles; face transversely excavated between antennal cavities, beneath overhanging frontal margin. See Pl. IV, 3 for a dorsal view of the head.

Each elytron with three nude basal foveae.

Mesothoracic tarsi abnormal.

Metathoracic tibiae each with an apical spur.

DISTRIBUTION

Published Records: Nacoochee ("Nakutshi")?, White County, Georgia and Vermont (LeConte, 1850); Virginia, Ohio and Kentucky (Brendel and Wickham, 1890); Cincinnati, Hamilton County, Ohio (Dury, 1903, 1908); southern half of Indiana (Blatchley, 1910); Indiana, Kentucky, Georgia, Ohio, Vermont and Virginia (Leng, 1920); Windsor, Broome County, New York (Notman, 1920); New York (Leonard, 1928); northeastern states (Bowman, 1934).

Material Examined: Enola, Cumberland County, PENNSYLVANIA (O.P.).

DISTRICT OF COLUMBIA (MCZ); GEORGIA (MCZ type 6170); ILLINOIS (MCZ); PENNSYLVANIA (MCZ); Alexandria, VIRGINIA (MCZ).

Batrisodes foveicornis (Casey)

Diagnosis: Male. Antennae with segment X as wide as XI, and bearing a large circular fovea in basal half of ventral face; XI with ventral face flattened in basal two-thirds (Pl. II, 5, 6).

Head with median vertexal carina absent to short; lateral vertexal carinae interrupted and relatively slight; vertexal foveae deep and nude; each fovea at base of a long, slightly arcuate foveal impression, the impression terminating mesiad of an antennal articulation, and consequently the circumambient sulcus not well formed. Front declivous and subglabrous between antennal articulations, the frontal declivity short and rapidly narrowed; front transversely impressed by a very short, shallow, but entire impression between the large antennal cavities, otherwise the face is simple (Pl. I, 2).

Each elytron with three basal foveae.

Last (fifth visible) sternite simple.

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic legs with abnormal tarsi, the ventral face of second tarsal segment notched at center.

Metathoracic legs with tibia bearing a long apical spur (Pl. III, 1).

DISTRIBUTION

Published Records: Tennessee (Casey, 1887); Cincinnati, Hamilton County, Ohio (Brendel and Wickham, 1890); Iowa City, Johnson County, Iowa (Wickham, 1896); Monroe County, Indiana (Blatchley, 1910); Tennessee, Ohio, Indiana (Leng, 1920); New York (Leonard, 1928); Tennessee (Bowman, 1934).

Material Examined: Types from TENNESSEE (USNM); TENNESSEE (O.P.); Mount Olivet, Robertson County, KENTUCKY (INHS).

Batrisodes cavicornis Casey

Diagnosis: Male. Antennae with segment X distinctly narrower than XI, and bearing an exceptionally large, deep fovea on basal two-thirds to three-fourths of ventral face, the fovea in several steps (Pl. II, 3); XI with ventral face obliquely concave in basal two-thirds.

Head with a rudimentary median vertexal carina that bisects cervicum, cervical sulcus and extends over occiput; lateral vertexal carinae entire and distinct; vertexal foveae deep and nude. Face essentially as in *foveicornis,* except that the rapidly narrowing frontal declivity has a more sharply defined ventral margin above the entire, but short transverse frontal impression.

Each elytron with three nude basal foveae.

Last (fifth visible) sternite simple.

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic legs with abnormal tarsi (Pl. III, 6), the second tarsomere suddenly notched on ventral face.

Metathoracic legs with tibia bearing a long apical spur.

Female. As for male except that the tenth and eleventh segments are simple; face simply and suddenly declivous, the declivity pubescent and not transversely impressed; mesothoracic tarsi simple.

DISTRIBUTION

Published Records: Westmoreland County, Pennsylvania (Casey, 1897); Pennsylvania and Ohio (Leng, 1920); Westmoreland County, Pennsylvania (Bowman, 1934).

Material Examined: Type from Westmoreland County, PENNSYLVANIA (USNM). Mammoth Cave National Park, Mammoth Cave, Edmonson County, KENTUCKY (O.P.); Eddyville, Pope County, ILLINOIS (O.P.).

Cincinnati, Hamilton County, OHIO (MCZ); St. Vincent, Westmoreland County, PENNSYLVANIA (MCZ).

Batrisodes punctifrons **(Casey)**

Diagnosis: Male. Antennae not conspicuously modified, segment X similar to IX except that it is larger; segment XI very large, about twice as wide as X, and nearly as long as the four preceding segments united.

Head with median vertexal carina absent or vestigial, at times a vestige bisecting the cervical sulcus; lateral vertexal carinae entire, from the large antennal incisures to the temporal angles; vertexal foveae deep and nude; circumambient sulcus entire, V-shaped, the apical end at the origin of the frontal declivity. Front evenly declivous on a line through antennal articulations and apex of circumambient sulcus; frontal declivity rapidly narrowing between antennal cavities, to end in a narrow truncate frontal margin; this declivity densely punctate, each puncture bearing a short, coarse, blunt, flavous seta; this declivity separated from the clypeus by a narrow, deep, entire transverse sulcus between antennal cavities; clypeus medianly bearing a short setose tubercle, these setae and those of the truncate frontal margin obscuring the transverse facial sulcus. Pubescence of frontal declivity illustrated on Pl. V, 8.

Each elytron with three deep, nude, basal foveae.

Last (fifth visible) sternite medianly less pubescent and distinctly flattened from base to apex.

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic legs with very abnormal tarsi (Pl. III, 12), the second segment sinuate above and deeply notched below.

Metathoracic tibia with an apical tibial spur.

Female. As for male except that antennal segment is both actually and relatively smaller; face abruptly declivous, not transversely impressed, lower half of clypeofrontal declivity densely punctate, and setose; last sternite shorter, pubescent, and bearing a narrow, shallow concavity in basal half; mesothoracic tarsi normal.

DISTRIBUTION

Published Records: Pennsylvania (Casey, 1887); southern Pennsylvania (Brendel and Wickham, 1890); Pennsylvania (Leng, 1920); New York (Leonard, 1928); Pennsylvania (Bowman, 1934).

Material Examined: PENNSYLVANIA type (USNM); St. Vincent, PENNSYLVANIA (O.P.)

Mt. Toby, MASSACHUSETTS (MCZ); Rumney, Grafton County, NEW HAMPSHIRE (MCZ); PENNSYLVANIA (MCZ).

Batrisodes appalachianus Casey

Diagnosis: Male. This species is very closely allied to *punctifrons.* It may be separated by the character of the frontal declivity. In *appalachianus* the frontal declivity is less uniformly punctate, and instead of each puncture bearing a short, stiff, flavous, blunted seta as in *punctifrons,* each puncture bears a very fine, inconspicuous, hair-like seta. I have found the best discrimination of this condition to be under a magnification of a 10 X objective, with strong illumination. See Pl. V, 9.

DISTRIBUTION

Published Records: Westmoreland County, Pennsylvania (Casey, 1908); Pennsylvania (Leng, 1920); Westmoreland County, Pennsylvania (Bowman, 1934).

Material Examined: Type from PENNSYLVANIA (USNM).

Batrisodes virginiae (Casey)

I do not know this species, and have placed it near *furcatus* (Brendel) on the basis of its published description (Casey, 1884, p. 90). The vertexal foveae are nude, connected by a feeble circumambient sulcus. The surface included between this sulcus and occiput is impunctate whereas the surface external to this sulcus is densely and strongly punctate. Anterior margin of the clypeus is transversely truncate and below a bifid horn. This horn arises from a short, broad, muzzle-formed frontal declivity. This frontal muzzle is medianly tuberculate, and laterally dentate below. Apical of the median tubercle, the muzzle narrows abruptly to form a flat, triangular, bifid horn noted above. Face transversely excavated beneath this overhanging frontal muzzle, between antennal cavities.

Prothoracic tarsi with the primary claw distinctly bifid, as in *furcatus.*

Metathoracic tibiae each bearing an apical spur.

Described from the male sex.

DISTRIBUTION

Published Records: Stone Creek, Lee County, Virginia (Casey, 1884); Virginia (Brendel and Wickham, 1890); Cincinnati, Hamilton County, Ohio (Dury, 1903, 1908); Virginia and Indiana (Leng, 1920); Stone Creek, Lee County, Virginia (Bowman, 1934); Round Knob, North Carolina (Brimley, 1938).

Batrisodes furcatus **(Brendel)**

Diagnosis: Male. Antennae with segment X subglobose, as wide as XI, with ventral face bearing a large fovea in basal two-thirds; XI simple, unmodified.

Head (Pl. IV, 2) with the median and lateral vertexal carinae well developed; vertexal foveae deep and nude; circumambient sulcus entire; eyes prominent. Front apically directed between antennal articulations as a flattened, narrowing shelf; the frontal, overhanging margin of this shelf is trilobed; the median lobe is slightly notched, and bears a pair of flavous, apically directed, strongly arcuate setiform processes; face deeply excavated beneath the trilobed frontal margin, between antennal cavities; clypeus long, with the apical margin medianly pointed.

Each elytron with three deep, nude, basal foveae.

Last (fifth visible) sternite medianly concave and laterally tuberculate.

Metasternum with a deep, narrow, median longitudinal sulcus.

Prothoracic legs with primary tarsal claw (Pl. III, 10) bifid.

Mesothoracic legs with tarsus normal.

Metathoracic legs with tibia bearing a short, bushy apical spur.

Female. Similar to male except that antennal segments X and XI are smaller and unmodified; face simply and evenly declivous, and not transversely excavated between antennal cavities; apical clypeal margin medianly rounded; fifth sternite medianly flattened, not laterally tuberculate; metathoracic legs with apical tibial spur longer and more conspicuous.

DISTRIBUTION

Published Records: Southern Pennsylvania (Brendel and Wickham, 1890); Pennsylvania (Leng, 1920); southern Pennsylvania (Bowman, 1934).

Material Examined: Northern ILLINOIS (O.P.); Warrens Woods, Lakeside, Berrien County, MICHIGAN (O.P.); St. Vincent, PENNSYLVANIA (O.P.); Tiptonville, nr. Reelfoot Lake, Lake County, TENNESSEE (O.P.).

Marion, Plymouth County, MASSACHUSETTS (FMNH); St. Vincent, and Reading, Berks County, PENNSYLVANIA (FMNH).

Thebes, Alexander County, Herod, Pope County, and Magnolia, Putnam County, ILLINOIS (INHS); Raleigh, Wake County, NORTH CAROLINA (INHS).

Marion, Plymouth County, MASSACHUSETTS (MCZ); St. Vincent, Westmoreland County, PENNSYLVANIA (MCZ); Fredericksburg, Spotsylvania County, VIRGINIA (MCZ).

Batrisodes sinuatifrons **(Brendel)**

Diagnosis: Male. Antennae placed at the lateral margin, so that they show the distinctive type of articulation to the roof of the epicranium, so characteristic of Pselaphidae, especially well; segment I elongate, thin, subconical, with the ventral face flattened; segment X as wide as XI, and bearing a fovea on the ventral face. This fovea is large, circular, deep, pubescent, and eccentrically placed in the mesiobasal portion of the ventral face. Segment X has the ventral face strongly flattened, so that the

segment appears subglobular from a dorsal view, and subsemicircular from a lateral view. Segment XI simple and unmodified. Pl. VI, 1.

Head with the large, quadrate dorsal surface entirely and coarsely punctate, the punctures large and crowded; median vertexal carina present but very much obscured by the coarse punctures; lateral vertexal carinae strong from temporal angles to a point anterior to the eyes, where the carinae tend to slant externally and disappear; eyes prominent; vertexal foveae small and nude; circumambient sulcus absent, and represented by a short, straight impression extending apically from each vertexal fovea. Front very broad, declivous apical of the antennal articulations, then abruptly and vertically declivous. This vertical declivity short, and the overhanging frontal margin extended as a pair of conspicuous horns. These horns are extended ventrally; each horn is pendant obliquely ventrolaterad, conical, blunted, apically setose, the setae forming a pencil of golden setae that turns abruptly into the frontal excavation. Face deeply and transversely excavated beneath the overhanging frontal margin, between the antennal cavities.

Each elytron with three nude basal foveae.

Last (fifth visible) sternite simply convex-flattened, with a very small median concavity at basal fourth.

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic tarsi normal.

Metathoracic tibia with an apical spur.

Female. As for male, except that the antennae are simple and unmodified; head with smaller dorsal surface, and the face is not transversely excavated. The face, nevertheless, is sharply marked into a dorsal, abruptly declivous front, between the antennal tubercles, that is coarsely and densely punctate, and a ventral, shining, subimpunctate clypeus. The apical clypeal margin is apically directed as a thin, shelf-like lamina. Last sternite evenly convex.

DISTRIBUTION

Published Records: Memphis, Shelby County, Tennessee (Brendel, 1893; Bowman, 1934); Tennessee (Leng, 1920).

Material Examined: Harahan, Jefferson Parish, LOUISIANA (INHS); Marianna, Lee County, ARKANSAS (INHS).
TENNESSEE (MCZ).

Batrisodes clypeonotus (Brendel)

Diagnosis: Male. I do not know this species, and have selected the following features from the published description.

Antennal segment I abnormal, the mesial face with the dorsal half smooth and shining, and the ventral half granulated; segment X large, globose, with the ventral face not bearing a fovea; segment XI not as wide as the tenth.

Vertexal foveae nude; circumambient sulcus not entire apically; vertexal carina present; declivous front with a broadly biarcuate frontal margin; face transversely excavated between antennal cavities, beneath this overhanging frontal margin; excavation bearing a pair of distant, black teeth; clypeus medianly tuberculate, this tubercle medianly slightly carinated.

Each elytron with three basal foveae.

Posterior tibiae each with an apical spur.

DISTRIBUTION

Published Records: Ponchatoula, Tangipahoa Parish, Louisiana (Brendel, 1893; Bowman, 1934); Louisiana (Leng, 1920).

Batrisodes luculentus (Casey)

Diagnosis: Male. I do not know this species, and have selected the following features from the published description.

Vertexal foveae nude; circumambient sulcus not entire apically; front declivous between antennae, the declivity longitudinally bi-impressed, the impressions setigerous; frontal margin bearing a pair of median teeth. Face transversely excavated between the antennal cavities, beneath the overhanging frontal margin.

Basal antennal segment with simple mesial face; segment X distinctly wider than XI.

Posterior tibiae each with an apical spur.

DISTRIBUTION

Published Records: District of Columbia (Casey, 1887; Bowman, 1934; Leng, 1920).

The next four species form the *nigricans* group. These four are *nigricans* (LeConte), *denticollis* (Casey), *schmitti* Casey, and *striatus* (LeConte); they agree in a number of features, including the possession of pubescent vertexal foveae.

Batrisodes nigricans (LeConte)

Diagnosis: Male. Antennae with several abnormalities, segment I with ventral face produced ventrally into a thin, conspicuous process that appears as a long, acute spine from a direct view of the mesial face, and as a subtruncate lobe from a direct view of the apical end of the segment; III longer than II or IV, with the mesial face slightly inflated in basal half (Pl. II, 11); X as wide as XI, with a large, deep fovea located eccentrically in mesiobasal area; XI with the basal margin of ventral face produced into a minute dentiform tubercle.

Head with median vertexal carina countersunk; lateral vertexal carinae low and broad; eyes prominent; vertexal foveae deep and lightly

pubescent; circumambient sulcus opening apically into the front. Front deeply, longitudinally sulcate between the conspicuous antennal tubercles, then abruptly and vertically declivous, these areas heavily pubescent with bristling setae that obscure many details. The frontal declivity noted bears a pair of triangular, apically directed teeth at center, and between these teeth, and lower down, is a pair of minute tubercles. These details are difficult to discern unless high magnification and strong illumination are used. Beneath this overhanging frontal margin, the face is deeply, transversely excavated between the antennal cavities. Clypeus also complex, the most peculiar feature of which is the formation of a high, narrow, long, subtriangular roll or tubercle medianly.

Each elytron with three deep, nude basal foveae.

Last (fifth visible) sternite medianly broadly flattened, with the apical angles continuing this flattened area as flat-topped tubercles.

Metasternum medianly, longitudinally sulcate.

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic legs with normal tarsi.

Metathoracic legs with tibia bearing an apical spur.

Female. Antennae unmodified, save that segment III is slightly longer than II or IV; front deeply depressed between the conspicuous antennal tubercles, this median sinus broadening into the evenly declivous frontoclypeus; front not transversely excavated between antennal cavities; last sternite convex, except for a small median concavity at base.

DISTRIBUTION

Published Records: "Columbiam Car. Australis" (South Carolina) (LeConte, 1850); Georgia (Brendel, 1887; Brendel and Wickham, 1890); Cincinnati, Hamilton County, Ohio (Dury, 1903, 1908); Lake County, Indiana (Blatchley, 1910); South Carolina, Indiana and Connecticut (Leng, 1920); ? New York (Leonard, 1928); eastern states (Bowman, 1934).

Material Examined: Lakehurst, Ocean County, NEW JERSEY (O.P.); sphagnum bog at Wyandanch, Suffolk County (Long Island), NEW YORK (O.P.).

Denver, Denver County, COLORADO (FMNH).[9]

Wyandanch, Suffolk County (Long Island), NEW YORK (MCZ); SOUTH CAROLINA (MCZ type 6171).

There has been considerable confusion concerning *nigricans* and its allies. A part of this is a consequence of a series of errors resulting in the establishment of *triangulifer* on incorrect morphological grounds.

Batrisodes triangulifer (Brendel)

This is a synonym of *nigricans* (LeConte). To the author, at least, this came as a great surprise, and it was not until the type of *nigricans* was studied that the facts could be appreciated.

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[9] See page 76.

Brendel (1887, p. 205) described *Batrisus spinifer* from Long Island, New York, stating that it differed from *nigricans* in having the "first antennal joint bearing a sharp thorn perpendicularly, causing the joint to appear triangular" in the male. In this paper, Brendel figured this antennal structure (1887, p. 205, fig. 1 and 2), and the antenna of *nigricans* was figured by G. H. Horn (1887, p. 205, fig. 3) with the footnote by Horn saying "I have inserted this figure from a sketch made from LeConte's male type."

Brendel and Wickham (1890, p. 9, and p. 28-30) changed the name of Brendel's species to *triangulifer,* noting that *spinifer* was preoccupied. I have searched the works of Raffray (1903-04, 1908, 1911) and my card catalogue of Pselaphidae but find no *Batrisodes spinifer* by another author, and think that the change from *spinifer* to *triangulifer* was unnecessary. In this 1890 work the two figures by Brendel and the figure by Horn were used to separate *nigricans* and *triangulifer,* and Leng (1920), Bowman (1934), Leonard (1928) and others followed this taxonomy.

The male type of *nigricans* (LeConte) is mounted on an oblong card, and the head has been fractured, but fortunately the antennal structure is not destroyed. In fact, the damage to the specimen probably occurred after Horn made his unfortunate sketch, since the pendant lobe of the first antennal segment may be quite inconspicuous if the antenna is directed so that this lobe fits closely against the curving wall of the acetabulum.

Study of the *nigricans* type (MCZ 6171) demonstrates that (1) first antennal segment is deceptive, the long pendant lobe is a thin, tapering, arcuate plate. When the segment is seen in lateral view (Pl. II, 11) the outline is flat and triangular; but when the segment is seen from a mesial view (VII, 5) only the sharp, thin triangular edge is obvious, and with low magnification and low illumination this pendant edge might be overlooked, probably the conditions that obtained when Horn saw it. (2) Antennal segment III is as described and figured in *nigricans,* but if the segment is not seen from a side view, the expanded depth is not obvious. Furthermore, the third antennal segment varies in this respect (Pl. II, 11 and Pl. VII, 5). (3) The tenth antennal segment is deeply foveate on the ventral face, not simple and unfoveated as noted by Brendel and Wickham (1890).

DISTRIBUTION

Published Records: Long Island, New York (Brendel, 1887; Brendel and Wickham, 1890; Leng, 1920; Bowman, 1934); Wyandanch, Suffolk County (type locality, in a sphagnum bog, *teste* C. W. Leng and A. S. Nicolay in Leonard, 1928), New York.

***Batrisodes denticollis* (Casey)**

Diagnosis: Male. Antennae with segment I with the ventral face produced ventrally as a rounded-triangular lobe (Pl. II, 10); X as wide as XI, with a fovea at basal third of ventral face.

Head with the median vertexal carina bisecting cervicum and cervical sulcus, but apt to be rudimentary on occiput and vertex; lateral vertexal carinae similarly poorly developed, and apt to be present only on temporal angles; antennal incisures and eyes prominent; vertexal foveae very large, deep and densely pubescent; circumambient sulcus tending to open on the front medianly. Front with a slightly declivous frontal margin between antennal articulations, this margin trilobed, the two lateral lobes large, the median lobe minute and apically setose; a pair of conspicuous, glabrous, conical teeth just below the minute median lobe. Front deeply excavated beneath the frontal margin, between antennal cavities.

Each elytron with three deep, nude basal foveae.

Last (fifth visible) sternite with a broad, transverse, median concavity from near apex to base.

Prothoracic legs with tarsal claw not bifid.

Mesothoracic legs with tarsi normal.

Metathoracic legs with tibia bearing a long, thick apical spur.

Female. Similar to male, except that the antennae are unmodified; circumambient sulcus entire; face strongly declivous between the prominent antennal tubercles, and not transversely excavated between antennal cavities; last sternite convex, with a small median basal concavity.

DISTRIBUTION

Published Records: Washington, District of Columbia (Casey, 1884; Bowman, 1934); Iowa and Virginia (Brendel and Wickham, 1890); Iowa, District of Columbia, New York and Illinois (Leng, 1920); New York (Leonard, 1928); Round Knob, North Carolina (Brimley, 1938).

Material Examined: Clayton, Rabun County, GEORGIA (O.P.); Dolson, and Urbana, Champaign County, ILLINOIS (O.P.); Baltimore, MARYLAND (O.P.); Palisades, Bergen County and South Orange, Essex County, NEW JERSEY (O.P.); Harrisburg, Dauphin County, PENNSYLVANIA (O.P.).

Iowa City and North Liberty, Johnson County, IOWA (FMNH); Washington, DISTRICT OF COLUMBIA (FMNH); St. Vincent, PENNSYLVANIA (FMNH); MISSOURI (CNHM).

Mayview, Champaign County and Astoria, Fulton County, ILLINOIS (INHS). PENNSYLVANIA (MCZ); Alexandria and Gt. Falls, VIRGINIA (MCZ).

Both *nigricans* and *denticollis* have the first antennomere ventrally produced, but the lobe is quite different in the two populations. In *nigricans* it is thin, rather saucer-like, with a thin edge that is very acute in lateral view. In *denticollis* the lobe is much shorter, rounded-triangular and thicker. Furthermore, the third antennomere is perfectly simple in *denticollis,* but distinctly deeper than the adjacent segments in *nigricans.*

Batrisodes schmitti Casey

Diagnosis: Male. Antennae abnormal. Segment I with ventral face inflated evenly to form an oblong with rounded corners, with the ventral face densely, finely setose (Pl. II, 12); X as wide as XI, with ventral face excavated and bearing a large, pubescent, eccentrically placed fovea at mesiobasal corner of excavation.

Head with a long median vertexal carina, from cervicum to center of vertex; lateral vertexal carinae entire, everted apically, from temporal angles to antennal incisures, so that the head appears wider through the antennal articulations than through the temporal angles; eyes prominent; vertexal foveae deep, pubescent; circumambient sulcus entire, strong, short. Front at first rapidly narrowed and slightly declivous between antennal articulations, then vertically declivous to a trilobed frontal margin. Median lobe of this margin slightly longer and opaque; lateral lobes wider, translucent. Median lobe bearing two pencils of ventrally-directed setae; lateral lobes each with a converging fringe of longer setae. Face deeply and transversely excavated beneath the overhanging frontal margin, between antennal cavities.

Each elytron with three deep, nude basal foveae.

Last (fifth visible) sternite relatively simple, with a small median concavity at base.

Metasternum with median, longitudinal sulcus deeper and broader apically to form a foveoid depression.

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic legs with normal tarsi.

Metathoracic legs with tibia bearing an apical spur.

Female. Well-marked for the genus. Antennae unmodified. Front more strongly declivous between antennal articulations than in the male, then vertically declivous to clypeal margin. Clypeal margin apically directed in a wide, thin shelf, medianly pointed. Frontoclypeal declivity not transversely excavated or impressed between the antennal cavities, but bearing a median and two lateral dorsoventral carinoid ridges. Otherwise as for male.

DISTRIBUTION

Published Records: Westmoreland County, Pennsylvania (Casey, 1897; Bowman, 1934); Pennsylvania (Leng, 1920).

Material Examined: Type specimen from PENNSYLVANIA (USNM); NORTH CAROLINIA (O.P.); Spring Mill Park, INDIANA (INHS); Beatty, PENNSYLVANIA (MCZ).

Batrisodes striatus (LeConte)

This is another well-marked species of the *nigricans* group (*nigricans, denticollis, schmitti, striatus*), and several synonyms of *striatus* are known:

1. *simplex* (LeConte), 1878, from Michigan, was based upon two immature females (Casey, 1893, p. 472).

2. *aterrimus* (Casey), 1884, from Massachusetts, was based upon the female sex (Casey, 1893, p. 472).

3. *cephalotes* (Casey), 1887, from New York (Casey, 1893, p. 472).

Diagnosis: Male. Antennae relatively simple; segment I with mesial face tending to be concave, with the concavity minutely granulated; III simple; X almost as wide as XI, with the ventral face not foveate.

Head with the median vertexal carina imperfectly developed to absent, at times represented on cervicum or occiput; lateral vertexal carinae similarly poorly developed to absent; eyes moderately prominent; vertexal foveae densely pubescent; circumambient sulcus poorly defined to wholly incomplete apically. Front broad and declivous between antennal articulations, then vertically declivous for a short distance, to form an overhanging frontal margin. Frontal margin bearing on each side a ventrally-directed, subtriangular fringe of converging setae; medianly the margin bears a variable number of subtriangular, recessed teeth. These recessed teeth are usually represented by a large median pair, but there is often a minute tooth laterad of each larger tooth, to give a quadridentate plate. Face deeply excavated transversely, beneath the overhanging frontal margin, between antennal cavities.

Each elytron with three nude basal foveae.

Last (fifth visible) sternite relatively simple and convex.

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic tarsi normal.

Metathoracic tibia with an apical spur.

Female. Antennae unmodified, with the usual relatively small tenth segment; face declivous and not transversely excavated; the circumambient sulcus poorly marked, but more complete. Otherwise as for the male sex.

DISTRIBUTION

Published Records: Pennsylvania (LeConte, 1850); Massachusetts to the Missouri river, north of the Ohio (*cephalotes* in Brendel and Wickham, 1890); Pennsylvania, Georgia, Massachusetts, Michigan, California (Leng, 1920); New York (Leonard, 1928); east of the Mississippi river; California? (Bowman, 1934).

Material Examined: ONTARIO, CANADA (O.P.); Palos Park, Cook County, ILLINOIS (O.P.); IOWA (O.P.); Rutherford, Bergen County and South Orange, Essex County, NEW JERSEY (O.P.).

Bowmanville, Chicago and Palos Park, Cook County, and Antioch, Lake County, ILLINOIS (CNHM); Iowa City, Johnson County, IOWA (CNHM); Wallace, Wallace County, KANSAS (CNHM); Portsmouth, Newport County, RHODE ISLAND (CNHM).

ILLINOIS (INHS); Natick, Middlesex County, MASSACHUSETTS (INHS).

PENNSYLVANIA (MCZ type 6169); Ridgeway, ONTARIO, CANADA (MCZ); DISTRICT OF COLUMBIA; Springfield, Hampden County and Tyngsboro, Middlesex County, MASSACHUSETTS (MCZ); Rutherford, Bergen County and Arlington, Hudson County, NEW JERSEY (MCZ).

Batrisodes tridens Casey

Diagnosis: Male. I do not know this species, and certain features have been selected from the published description.

First antennal segment large, strongly rounded beneath, compressed, with the mesial face bearing a large oval concavity, this cavity minutely granulatopunctate; X large, subglobose, slightly wider than XI, with the ventral face only slightly modified, bearing a small, rounded, subbasal areola or concavity.

Vertexal foveae nude; frontal margin bilobed, the sinus between the lobes bearing a short lamina that is apically tridentate; face excavated between the antennal cavities, beneath the overhanging frontal margin.

This species would appear to be near *striatus* (LeConte), but differs from the latter species in having nude vertexal foveae.

DISTRIBUTION

Published Records: St. Louis, Missouri (Casey, 1908; Bowman, 1934); Missouri (Leng, 1920).

Batrisodes kahli Bowman

Diagnosis: Male. I do not know this species, and have selected certain features from the published description.

Antennal segment X transversely globose, slightly wider than XI, with the ventral face simple, not bearing a fovea.

Vertexal foveae nude, broad and shallow; circumambient sulcus broad, shallow and entire; integument external to this sulcus densely and coarsely punctate, but surface enclosed by sulcus smooth; overhanging frontal margin bearing a pair of small, rounded tubercles near middle, and a larger acute spine near each lateral corner of the margin; face transversely excavated between antennal cavities, beneath overhanging frontal margin.

Posterior tibiae each with an apical spur.

This species is said to be most comparable to *clypeonotus* (Brendel), from which it is distinct in having the first antennal segment short, stout and uniformly punctate.

DISTRIBUTION

Published Records: Tennessee (Bowman, 1934).

Batrisodes caseyi Blatchley

Diagnosis: Male. I do not know this species. It may be coincidence, but specimens bearing the name of this species, and submitted to me for identification, have all been *ionae* (LeConte).

It is described as of a uniform reddish to chestnut brown, with sparse, stiff, suberect yellowish pubescence. The head is large, as wide as pronotum, with a strongly swollen and uncarinated vertex. Vertexal foveae very small. Antennae short and stout, with segments II to X inclusive wider than long, and XI oblong oval and almost as long as the three preceding segments. Pronotum as wide as long, with a deep median sulcus that is apically abbreviated, and with deep subbasal pronotal foveae. Elytra smooth, convex, with humeri not prominent. 2.5 mm. long.

Desiderata are data on number of basal elytral foveae per elytron, structure of distal antennal segment, and structure of the mesothoracic femora.

DISTRIBUTION

Published Records: Posey County, Indiana and Kentucky, opposite Cincinnati, Ohio (Blatchley, 1910); Ohio and Indiana (Leng, 1920); Cincinnati, Hamilton County, Ohio; Posey County, Indiana; Covington, Kenton County, Kentucky (Bowman, 1934).

DESCRIPTION AND INTEGRATION OF NEW SPECIES

Batrisodes sandersoni **new species**

Type. Head 0.33 mm. long x 0.45 mm. wide; cervicum 0.7 mm. long; pronotum 0.45 mm. x 0.45 mm.; elytra 0.56 mm. x 0.67 mm.; abdomen 0.6 mm. x 0.67 mm.; total length, with head extended so that cervicum is not counted, 1.9 mm.

Reddish-brown, with paler palpi and legs. Pubescence rather coarse, long, semiappressed and golden.

Head with rudimentary eyes of about 12 facets each, typical of females of the *monstrosus* group; supraocular carina present; lateral vertexal carina present from temporal angle to antennal incisure; occiput with three apically converging carinae, a median longitudinal and a right and a left oblique, as in *monstrosus, armiger* and *cavicrus;* the median carina subserrate and extending from a point between, and anterior to, the vertexal foveae, to the pronotum; vertexal foveae deep and nude; circumambient sulcus entire; front dorsally concave between antennal tubercles, then vertically declivous; frontoclypeus not transversely excavated, but bisected by a dorsoventral carina from the arcuate interantennal line to the center of the clypeal margin; clypeal margin developed at right angles to clypeus, as a thin shelf, the clypeal margin evenly rounded when seen from above; labrum broadly arcuate; maxillary palpi and genal beard as for genus; antennae simple and unmodified, as in *cavicrus.*

Pronotum with a median and a right and a left subbasal fovea of nearly equal size; median fovea connected to basal bead by a longitudinal carina; disc rather flat, bisected by a very feeble sulcus that extends from median fovea to apical fifth; lateral longitudinal sulcus very weakly developed from each lateral fovea; lateral discal carina, between median and lateral sulci on each side, represented by a low conical tumulus, between lateral and median fovea, and apically by two strong, recurved teeth on disc. Lateral pronotal margin each side bearing an acute spine directed dorsoposteriorly (Pl. VI, 3), as in *carolinae.*

Each elytron with sloping humeral angle armed with a small tooth; flank with the usual nude subhumeral fovea and longitudinal sulcus; base with three deep, nude foveae; the sutural fovea at origin of entire sutural stria, and this fovea close to discal fovea, so that the two lie in a sutural impression; humeral fovea distant from these two foveae, at origin of a rather deep longitudinal impression that extends to middle of elytral length; surface between these two impressions narrow and linear, appearing like a discal costa.

Abdomen with margins lacking, and marginal carinae as in the genus; five visible tergites; first tergite with a pair of median basal carinae, these carinae one-fourth as long as segment, and separated at their tips by one-fifth of the entire segmental width; five sternites completely visible from side to side, and another sternite, largely obscured by coarse pubescence, discernible between mesial angles of metacoxae; last sternite as long as the first completely visible sternite, with a basally deepening, semicircular impression in basal half.

Legs simple and unmodified, with normal tarsi and the metathoracic tibiae lacking apical spurs.

Described on one female, the type specimen, collected by Herbert H. Ross and Milton W. Sanderson at Herod, Pope County, Illinois on April 15, 1944; named for Dr. Sanderson, type deposited at the Illinois Natural History Survey.

This species is rapidly discriminated from its allies. It is a member of the *monstrosus* group, and has the tricarinate occiput of *cavicrus,* and the spined pronotal margin of *carolinae;* no other species of the group has this combination of characters.

The *monstrosus* group is sharply set off from all other groups of *Batrisodes* in the Nearctic Region by the complete absence of tibial spurs. This group, so far, is not known beyond the limits of the deciduous forest biome of North America.

At present it consists of six species. The female sex has rudimentary, inconspicuous eyes of six to fourteen facets; the male sex has large, prominent eyes of forty or more facets.

The aedeagus of *Batrisodes* is highly specialized, with notable reduction of parts, and a developing bilateral asymmetry. Among species studied so far, this tendency apparently culminates in *monstrosus*. Whereas the aedeagus is bilaterally symmetrical in *furcatus* and *riparius*, and progressively asymmetrical in *globosus*, *denticollis* and *schaumi*, this organ becomes not only very asymmetrical in *monstrosus*, but develops a movable accessory piece (Park, 1942, p. 15-17, Pl. I, fig. 11-14, Pl. II, fig. 1-5). The aedeagus of *monstrosus* is so far removed from that of other *Batrisodes* studied, that it should serve to separate this group as a subgenus, if further research demonstrates that the other allied species have male genital apparatus of the general *monstrosus* type.

Contrary to older accounts, all species of this group have three basal elytral foveae on each elytron, the sutural fovea set close to the suture and often overlooked.

Males are strongly modified. In *monstrosus* and *armiger* the tenth antennal segment is excavated; *armiger* has the eleventh antennal segment spined; prothoracic tibia medianly toothed in *monstrosus* and *armiger*, and the mesothoracic femur deeply notched in these two species; the metathoracic trochanters are spined in *monstrosus*, *armiger*, *confinis*, *cavicrus*, and *carolinae*; *armiger* has the second segment of the metathoracic tarsus greatly swollen.

The following key integrates *sandersoni* with other members of the group, in so far as the known sexes permit.

KEY TO BOTH SEXES OF THE SPECIES OF THE MONSTROSUS GROUP

1 Eyes rudimentary, consisting of from 6 to 14 facets (FEMALES) 2
Eyes normal and prominent, consisting of 40 or more facets (MALES) 5

2 (1) Occiput with three apically converging carinae: a median, and a right and a left oblique carina 3
Occiput with only a median longitudinal carina *confinis* (LeConte).

3 (2) Lateral pronotal margin bearing a posteriorly-directed spine on each side (Pl. VI, 3); only female known *sandersoni* new species.
Lateral pronotal margin lacking this spine (Pl. VI, 4) 4

4 (3) Relatively large, 2.4 to 2.6 mm. long *monstrosus* (LeConte).
Relatively small, 1.7 to 2.0 mm. long *cavicrus* Casey.

5 (1) Occiput with three apically converging carinae: a median, and a right and a left oblique carina 6
Occiput with only a median longitudinal carina; only male known *carolinae* Casey.

6 (5) Prothoracic tibia with a conspicuous tooth or tumulus near center of dorsal face — 7
Prothoracic tibia lacking this tooth — *cavicrus* Casey.
7 (6) Second tarsomere of metathoracic tarsus greatly swollen, ovate, as wide or wider than tibial apex; only male known — *armiger* (LeConte).
Second tarsomere of metathoracic tarsus simple, compressed-cylindrical, much narrower than tibial apex — *monstrosus* (LeConte).

Batrisodes rossi **new species**

Type. Head 0.42 mm. long x 0.42 mm. wide; pronotum 0.42 mm. x 0.42 mm.; elytra 0.60 mm. x 0.67 mm.; abdomen 0.60 mm. x 0.56 mm.; total length 2.0 mm.

Light reddish-brown with paler appendages. Pubescence long, semi-erect and flavous.

Head with eyes moderately prominent, of more than forty facets; no supraocular carina; lateral vertexal carinae entire, subparallel from temporal angles to antennal incisures; median vertexal carina long, entire from apical pronotal margin to center of vertex between the foveae; vertexal foveae deep, nude; circumambient sulcus deep in front of each fovea, becoming shallow anteriorly, and very difficult to trace at its apical margin where the sulcus becomes obscured by the frontal sculpture; interfoveal integument strongly shining and subimpunctate, clothed with a few long erect setae that converge apically to arch over the interfoveal center; front gently convex between antennal incisures, then gently declivous between antennal articulations; this frontal declivity progressively narrowed apically, to form a blackened, overhanging frontal margin; frontal margin medianly transversely sinuate, the external angles of the sinuation triangular; frontal declivity slightly concave laterally and convex medianly, entirely granular and setose; face simply and transversely excavated beneath frontal margin, between antennal cavities, the excavation simple and setose; clypeus rather simple, no definite clypeal margin present, the apical outline, from above, narrowly rounded, the apical portion longitudinally thickened and visible between the angles of the frontal sinuation, but with no erect clypeal tubercle or other modification.

Antennae with first segment simple, elongate; II to VII narrower than first, elongate; VIII quadrate; II toVIII subequal in width; IX as wide as first, transverse; X much larger, one and a half times the width of first, subspherical, with a small perforate fovea on ventral face at basal seventh (Pl. VI, 2); XI wider than tenth, as long as preceding three segments united, ventral face simple, subconvex, and not spined.

Pronotum with reduced sculpture; median sulcus and lateral sulci rudimentary, shallow and not extending beyond median third of total pronotal length; median and lateral subbasal foveae subequal in size, the median connected to basal bead by a longitudinal carina; lateral discal carinae rudimentary, each extended forward a short distance from an acute, low subbasal tumulus; lateral pronotal outlines simple and unspined.

Each elytron with humeral angle oblique, smooth and unarmed; flank with the usual subhumeral fovea and longitudinal sulcus of the genus; three deep, nude basal foveae; sutural stria entire; discal impression very short, weak and subbasal in extent.

Last sternite simply convex.

Metasternum medianly flattened, the flattened area longitudinally sulcate, the sulcus deepened apically into a fovea between the mesial angles of the metathoracic coxae.

Prothoracic legs simple, primary tarsal claw not bifid.

Mesothoracic legs with very abnormal tarsi of the *punctifrons* type (Pl. III, 12), the second segment sinuate above and deeply notched below.

Metathoracic legs with the tibia bearing a long apical spur.

Described on one male, the type specimen, collected by Herbert H. Ross and Milton W. Sanderson at Herod, Pope County, Illinois on April 18, 1944; named for Dr. Ross; type deposited at the Illinois Natural History Survey.

This species is a member of the *punctifrons* group. It may be differentiated from *punctifrons* and *appalachianus* by the structure of the face, and the antennal club. These two species have the tenth antennal segment relatively small, similar to the ninth segment in form but normally larger, and with the ventral face not foveate; the eleventh segment is relatively very large. In *rossi* the tenth antennal segment is relatively large, subspherical and foveate beneath; the eleventh segment is of normal size.

Batrisodes hairstoni **new species**

Type. Head 0.45 mm. long x 0.47 mm. wide through eyes; pronotum 0.45 x 0.42 mm.; elytra 0.60 mm. x 0.67 mm.; abdomen 0.56 mm. x 0.67 mm.; total length 2.06 mm.

Reddish-brown with paler palpi and legs. Pubescence moderately long, semiappressed, flavous.

Head with prominent, rounded eyes of about 48 facets; supraocular carinae absent; lateral vertexal carinae strong, entire from temporal angle to a point just behind antennal incisures, slightly everted in apical half to approach the condition in *schmitti;* median vertexal carina strong over cervicum and cervical sulcus, and weakly developed over occiput, ending at a line through posterior margins of vertexal foveae; vertexal

foveae deep, nude; circumambient sulcus v-shaped, incomplete apically but deep from each fovea; interfoveal surface subimpunctate; front declivous on a line through antennal articulations, extending apically to a broad frontal margin; frontal margin, when seen from above, undulated, when seen directly, transverse with rounded corners and a small median lobe; frontal declivity set with sparse, coarse, shallow punctures and sparse, apicoventrally directed setae; front transversely excavated beneath the overhanging frontal margin, between antennal cavities, the excavation simple and densely setose; clypeus simple, medianly thicker to form a blunt, setose swelling, and with a broadly ogival apical margin.

Antennae with basal segment simple and elongate; II to VII subequal in width, slightly elongate; VIII subquadrate; IX asymmetrically transverse, the mesial face much shorter than lateral face; X abnormal, very slightly narrower than eleventh, slightly transverse, subcircular from a dorsal view, ventral face asymmetrical, strongly flattened, bearing a large, setose, eccentric fovea over half of surface (Pl. VI, 5); XI abnormal, only slightly wider than tenth but as long as three preceding segments united, ventral face with the longitudinal convexity strongly angulated at middle, the basal half of the convexity flattened obliquely, with a minute tooth set near base (Pl. VI, 5).

Pronotum with sculpture greatly reduced; the median and right and left lateral sulci evanescent, not reaching disc; the median and right and left lateral subbasal foveae subequal in size; the interposed right and left lateral subbasal tumuli and longitudinal carinae rudimentary; median subbasal fovea connected to basal bead by an exceptionally strong longitudinal carina.

Elytra, metasternum, and last sternite as described for *rossi.*

Prothoracic legs with primary tarsal claw not bifid.

Mesothorocic legs with very abnormal tarsi, as in *cavicornis* and *punctifrons* (Pl. III, 6, 12).

Metathoracic legs with the tibia bearing a long apical spur.

Described on one male, the type specimen, taken on May 1, 1947, from the stomach of a red-backed salamander, *Plethodon cinereus cinereus* (Green), under a rotting log in the Clark County State Park, near Uno, Indiana, about thirteen miles north of the Ohio River. Named for Nelson G. Hairston, of the Department of Zoology, Northwestern University, under whose direction the salamander was collected. Stomach analysis was made by the author.

This new species is especially notable as a consequence of the ecological record. The food of adult pselaphids is known. They are predaceous, and this has been known since 1825, when Henry Denny noted that

British species fed upon mites in damp situations. Their mite-devouring proclivities have been checked by subsequent observations, both in the field and in laboratory (Park, 1942, 1947). In addition to mites, pselaphids are known to feed upon a variety of other foods, including earthworms, small flies, and dead ant larvae, living ant larvae, and ant eggs (Park, 1932a, b, 1933).

By contrast, no definite information was at hand as to the enemies of pselaphids. Consequently this is the first record of predation, and serves, in small measure, to extend the food-chain.

When the amphibian's stomach was opened, the contents were found to consist of several ants (*Aphaenogaster* sp.), several of the large gamasid mites often taken in the nests of such ants, and the specimen of *Batrisodes hairstoni*. Since *Aphaenogaster* is common in log mold, and is known to be the host of several species of *Batrisodes* (Park, 1935), it seems safe to assume that the salamander was feeding upon an *Aphaenogaster* colony, and ate the beetle and mites as well.

This assumption is tenable if *hairstoni* is an inquiline, and it must not be forgotten that another alternative is available, namely that *hairstoni* may not be inquilinous, and that the salamander ate it in the log mold, independently of the ants.

Fortunately the salamander was killed, and its stomach injected with alcohol, before digestive action had damaged the contents. The beetle, ants and mites were in perfect condition.

Furthermore, there is nothing unusual about the salamander eating these arthropods. In a recent study of the food of *Plethodon cinereus*, Jameson (1944) reported upon the contents of 169 stomachs. Insects composed 73 per cent of the total contents, beetles formed 20 per cent of total, and ants 4 per cent. Therefore, not only is *Plethodon cinereus* known to have eaten a pselaphid, but salamanders, toads and wood frogs may be assumed to be natural enemies of these beetles as a general consequence of the record cited, and the general food-habits of these amphibians.

The type of *hairstoni* is in the author's collection. This species is allied to those *Batrisodes* having the mesothoracic tarsi abnormal: *riparius*, *uncicornis*, *antennatus*, *foveicornis*, *cavicornis*, *punctifrons*, *appalachianus*, and *rossi*.

Of this group *punctifrons* and *appalachianus* can be separated from *hairstoni* by the tenth antennal segment lacking a fovea, and from *rossi* by the very minute fovea of the tenth antennal segment.

Of the remaining five, *foveicornis* and *cavicornis* are quickly separable since they have a very shallow, transverse frontal impression; *riparius* and *uncicornis* have the eleventh antennal segment prominently spined; *antennatus* has a qualitatively different antennal club (Pl. II, 9).

Batrisodes schaefferi **new species**

Holotype male. Head 0.37 mm. long x 0.42 mm. wide; pronotum 0.37 mm. x 0.37 mm.; elytra 0.53 mm. x 0.60 mm.; abdomen 0.53 mm. x 0.60 mm.; total length 1.80 mm.

Dark reddish-brown with paler appendages; pubescence moderately long, semierect and flavous. Integuments very finely alutaceous.

Head with moderately prominent eyes of about 44 facets; supraocular carina absent; lateral vertexal carinae present from temporal angle to antennal incisure, each side; median vertexal carina absent on vertex, and only weakly formed over cervicum; vertexal foveae deep and nude; circumambient sulcus not entire, sharply interrupted apically; front gently declivous from a line through antennal articulations; the short frontal declivity set with rather large, sparse, shallow punctures, the declivity narrowing anteriorly between antennae to a transverse margin; frontal margin blackened, granulated, and simple, not provided with any teeth; front transversely excavated beneath the overhanging frontal margin, between antennal cavities, the excavation simple, not provided with teeth, but densely setose; clypeus seen from above with a semicircular apical margin, and medianly erected into a clypeal tubercle; this clypeal tubercle conical and erect, setose.

Antennae with the basal segment elongate, the mesial face flattened and minutely granulated, with the ventral outline arcuate; II and III elongate; V and VII slightly larger than IV, VI, or VIII; IX as wide as first, transverse, with the ventral face much shorter than dorsal face; X large, subspherical, as wide as eleventh, with a minute fovea on basal five-sixths of ventral face; XI equal to tenth in width, of normal shape with a convex ventral face, as long as preceding three segments united.

Pronotum with the rudimentary sculpture as described for *hairstoni*, except that the longitudinal carina connecting the basal bead with the median subbasal fovea is incomplete, and does not reach the fovea. Elytra, metasternum and last sternite as in *hairstoni*.

Prothoracic legs with the femur bearing a well-developed pad of short, oblique, dense setae at base of ventral face near trochanter; primary tarsal claw not bifid.

Mesothoracic legs with the trochanter bearing a short, aciculate spine at apex of ventral face; tarsi relatively normal, the ventral face of second segment slightly sinuate (Pl. VI, 6).

Metathoracic legs with tibia bearing a strong apical spur.

Allotype female. Similar to male, except that the entire face is declivous, not transversely impressed or excavated, not bearing a median dorsoventral carina, clypeus densely and finely granulato-punctate, the

clypeal margin slightly reflexed, thin and broadly ogival seen from above; antennae with basal segment with a convex ventral outline and slightly granulated, but mesial face not flattened, segment X of relatively normal proportions and with the ventral face not foveate; prothoracic femur not bearing a setose pad; mesothoracic trochanter not bearing a spine or tooth, and the tarsi perfectly normal.

Described on one pair, holotype male and allotype female, in the author's collection. These two specimens were in the original Charles Schaeffer collection, and bore the notation "*Batrisodes* n.sp." After examination had confirmed that they represented a species that was undescribed, it was a pleasure to name the new species for their late owner.

The label gave the locality as North Carolina, without further data.

Batrisodes striatus psotai **new variety**

Type. Similar to *striatus* (LeConte), except that the ventral face of the tenth antennal segment bears a large, glabrous foveoid depression.

Described on a male specimen, collected by F. Psota on May 8, 1930 at Antioch, Lake County, Illinois, deposited in the Chicago Natural History Museum.

Batrisodes striatus is a variable species, and one of the labile features is the ventral surface of the tenth antennal segment. In a long series of specimens, from many localities within the range of the population, the ventral face of this segment has been found to vary. The ventral face may be perfectly convex; it may bear a subcircular flattened surface; it may bear a very shallow, subcircular depression; the rim of such a depression may be higher on one side than the other; an extreme condition, described in *psotai,* shows the depression as a deeper, foveoid concavity. In no case is a true, perforate, deep fovea developed with rim setae. Consequently, if such extreme variations are taken through the key on the assumption that the depressions are foveae, the specimens would diverge from all known North American species of *Batrisodes* and unjustified confusion would result.

The *nigricans* group is a compact assemblage of species, all having pubescent vertexal foveae and a common habitus. The females are less easily separated than are the males. The following partial key integrates the new variety, and may serve a useful subsidiary purpose.

KEY TO THE SPECIES OF THE NIGRICANS GROUP

1 Face transversely excavated between the antennal cavities (MALES) 2
Face simply declivous from interantennal line to clypeal margin, not transversely excavated (FEMALES) 6

2 (1) Antennomere I with the ventral face produced ventrally as a glabrous triangular spine or pendant lobe 3
Antennomere I with ventral face not as described 4

3 (2) Antennomere III slightly longer than either II or IV, and the ventromesial face slightly to strongly swollen *nigricans* (LeConte).
Antennomere III simple, slightly shorter than II *denticollis* (Casey).

4 (2) Antennomere I with ventral face uniformly inflated and flattened to form a rounded-oblong, densely, minutely setose (Pl.II,12); ventral margin of overhanging front developed into a small, rounded-triangular lobe *schmitti* Casey.
Antennomere I with ventral face normally convex; ventral margin of overhanging front developed into a pair of blunted, rounded-triangular teeth 5

5 (4) Ventral face of antennomere X bearing a subcircular, glabrous, foveoid depression *striatus psotai* new variety.
Ventral face of antennomere X evenly convex or flattened *striatus* (LeConte).

6 (1) Antennomere III slightly longer than II *nigricans* (LeConte).
Antennomere III distinctly shorter than II 7

7 (6) Facial declivity bisected by a median dorsoventral carina or carinoid ridge *schmitti* Casey.
Facial declivity lacking this ridge 8

8 (7) Top of head distinctly and rather suddenly narrowed on a line passing just apical to anterior eye margins; apical clypeal margin tending to be medianly reflected or elevated *denticollis* (Casey).
Top of head subquadrate in outline, the narrowing just apical of eyes much more gradual and slight; apical clypeal margin tending to be simple, and not medianly elevated or reflected *striatus* (LeConte).

Species of nearctic *Batrisodes* are divisible into a number of groups. Considerable study of possible groupings, based on the aedeagus where feasible, secondary sexual modifications, general habitus and other features, led to the separation of as many as twenty-two groups and as few as nine groups. Not all of the groups are of equal rank. For example, the *monstrosus* group could be separated as a subgenus on the basis of the bilaterally asymmetrical aedeagus with its associated accessory piece (Park, 1942) and the absence of spurs on the posterior tibiae. More investigation is needed before such a course could be adopted. Again, several groups have a pronounced habitus that quickly separates each of them.

This is especially notable for the *monstrosus*, *scabriceps*, *lineaticollis*, and *nigricans* groups. In other examples, such as the *riparius* group, a number of apparently very dissimilar species are united in the possession of very abnormal tarsi on the intermediate legs of the males. The subject of groupings within the genus will be dealt with later, in a paper covering the western species of the genus. For the present, the following group key, and list of group compositions will serve to denote some progress.

Two species have not been allocated to any group. *Batrisodes tridens* Casey has affinity with the *nigricans* group but lacks pubescent vertexal foveae; *Batrisodes schaefferi* new species has affinity with some species of the complex *riparius* group but serves to connect this latter assemblage with the other nearctic species by having the male mesotarsi only slightly abnormal.

KEY TO A TENTATIVE GROUPING OF NEARCTIC BATRISODES

1 Posterior tibiae lacking apical spurs (Pl. III, 3) I. MONSTROSUS GROUP.

Posterior tibiae each with an apical spur (Pl. III, 1, 2) 2

2 (1) Males with the mesothoracic tarsi abnormal (Pl. III, 6) IX. RIPARIUS GROUP.

Males with the mesothoracic tarsi normal (Pl. III, 5) 3

3 (2) Vertexal foveae pubescent VIII. NIGRICANS GROUP.

Vertexal foveae nude 4

4 (3) Males with face transversely excavated between the antennal cavities (Pl. I, 1) 7

Males with face not transversely excavated between the antennal cavities (Pl. I, 3) 5

5 (4) Species not found west of the Great Plains 6

Species not found east of the Rocky Mountains II. ALBIONICUS GROUP.

6 (5) Males with mesothoracic femur bearing a conspicuous, arcuate, blunted spine on ventral face (Pl. III, 3) III. IONAE GROUP.

Males with no mesothoracic femoral spines VII. LINEATICOLLIS GROUP.

7 (4) Males with the front produced between the basal segments of antennae as a long, ogival arc (Pl. IV, 1) V. FRONTALIS GROUP.
Males with the front not produced in this way, but usually diversely modified 8

8 (7) Males with the scabroid frontal declivity bearing a conspicuous, glabrous, semicircular excavation on which are placed two pairs of minute tubercles (Pl, VII, 2, 3) IV. SCABRICEPS GROUP.
Males with frontal declivity not so organized, but usually with a distinct pair of teeth on the overhanging frontal margin (Pl. IV, 2) VI. FURCATUS GROUP.

TENTATIVE GROUP ALLOCATIONS OF NEARCTIC BATRISODES

I	II	III	IV	V
armiger	albionicus	*? caseyi*	scabriceps	*beyeri*
carolinae	*aphaenogastri*	ionae	*temporalis*	frontalis
cavicrus	*cicatricosus*	*schaumi*		*globosus*
confinis	*denticauda*			
monstrosus	*lustrans*			
sandersoni	*mendocino*			
	monticola			
	occiduus			
	pygidialis			
	speculum			
	tulareanus			
	zephyrinus			

VI	VII	VIII	IX	Unallocated
furcatus	*bistriatus*	*denticollis*	*antennatus*	*schaefferi*
sinuatifrons	*cartwrighti*	nigricans	*appalachianus*	*tridens*
—	*declivis*	*schmitti*	*cavicornis*	
? clypeonotus	*fossicauda*	*striatus*	*foveicornis*	
? kahli	lineaticollis		*hairstoni*	
? luculentus			*punctifrons*	
? virginiae			riparius	
			rossi	
			spretus	
			uncicornis	

GENERAL ECOLOGY OF THE GENUS

There is notably even less information available on the ecology of *Batrisodes* than there is on the taxonomy of the genus. Futhermore, most of these data refer to the most abundant and best known species, *globosus.*

Habitat. In common with pselaphids in general (Park, 1942, 1947), the species of *Batrisodes* inhabit two chief types of habitats. These are the moist, dark, organic debris of leaf and log mold on the floors of rich forests, and the nests of ants. In addition to forests and ant societies, the genus is found in several less frequented habitats.

For example, they may be sifted from dried grass and weeds along the margins of meadows (*striatus*); certain species have been taken in the nests of the termite *Reticulitermes flavipes*, especially *spretus* (Blatchley, 1910, p. 327); and other species are cavernicolus.[10]

The forest habitat may be considered as the primitive or historical home of the genus. Many species live in the leaf debris and mold on the forest floor, in decayed log mold, beneath loosened bark, and in the discontinuous extensions of the forest floor, the tree-holes.

As will be seen presently, the general behavior of species of *Batrisodes* to relatively low light intensities and relatively high concentrations of moisture, together with their nocturnalism, tend to restrict the populations to dim, moist forest mold or to place a positive selection value upon such habitats (Park, 1947).

It is not surprising, therefore, that the species have entered, and become adjusted to, the dark, moist, well-stocked societies of ants in the course of their evolution.

Within a given area, certain species are found almost exclusively in floor mold, others are found almost exclusively in ant nests (*monstrosus*), whereas others (*globosus*) are facultative in this respect, and may be taken both in floor duff and in the ant society (Park, 1942). In such cases, other things being equal, the species that are the constant guests of ants are to be considered more highly evolved or specialized, than are the facultative mold/nest dwellers. Such an assumption rests on general evolutionary grounds rather than upon particular morphological detail, since the litter is assumed to be a more ancient home than the ant society.

Finally, as will be suggested later in a discussion of the LeConte Hypothesis, latitude may bear upon the problem of habitat tolerance.

Turning more especially to the ant society, those species of *Batrisodes* that live wholly or partially with ants are integrated in this amazonian

[10] These cavernicolous species of *Batrisodes* are not taken up in the present paper. They form a portion of a new and spectacular pselaphid fauna of Alabama caves. These species were collected by Dr. W. B. Jones and others (Löding, 1945, p. 42), and were sent to me for analysis by Dr. J. M. Valentine. This study is in process, and the results will be communicated elsewhere.

pattern in the rôle of synoeketes. That is, they are inhabitants of the nest and, as such, are not actively persecuted by the host, and are usually indifferently tolerated. See Wasmann (1894), Wheeler (1910, 1923), Park (1942, 1935b).

The details of occurrence of the genus with ants, in the area under discussion, are summarized in the following table.

TABLE I

RECORDS OF BATRISODES FOUND WITH ANTS

Species	Host	Source of data
aphaenogastri	*Aphaenogaster occidentalis*	Fall, 1912
bistriatus	*Formica exsectoides*	Amagansett, Suffolk Co., New York 21.IX.10. W. T. Davis
fossicauda	*Formica exsectoides*	Wickham, 1900
	Formica subsericea	Wickham, 1900
foveicornis	*Lasius aphidicola*	Wickham, 1896
frontalis	*Lasius claviger*	Wickham, 1898
	Lasius americanus	Wickham, 1900
	Lasius aphidicola	Park, 1935a
	Lasius aphidicola	Urbana, Champaign Co., Illinois 22.V.34. O. Park
globosus	*Camponotus pennsylvanicus*	Schwarz, 1890
	Lasius americanus	Schwarz, 1890
	Camponotus herculeanus	Wickham, 1898
	Lasius americanus	Wickham, 1900
	Lasius aphidicola	Wickham, 1900
	? *Formica ulkei* or *exsectoides*	Blatchley, 1910
	With ants, host not specified	Leng and Nicolay, in Leonard, 1928
	Formica ulkei	Holmquist, 1928
	Formica ulkei	Park, 1929
	Lasius americanus	Park, 1932
	Lasius americanus	Park, 1935a
	Formica ulkei	Park, 1935b
	Formica subsericea	Park, 1935a
	Camponotus noveboracensis	Park, 1935a
	Lasius americanus	Springfield, Sangamon Co., Illinois 25.IV.26. O. Park
	Lasius americanus	Madison, Dane Co., Wisconsin 26.V.29. O. Park
	Camponotus noveboracensis	Cambridge, Dane Co., Wisconsin 26.V.29. O. Park
	Lasius aphidicola	Yorkville, Kendall Co., Illinois 28.IV.42. O. Park

Species	Host	Source of data
globosus	*Lasius americanus*	Wheaton, DuPage Co., Illinois 16.V.42. O. Park
	? *Lasius aphidicola*	Tremont, Porter Co., Indiana 21.V.47. E. Ray
	Lasius aphidicola	Tremont, Porter Co., Indiana 21.V.47. Patricia Park
	Camponotus noveboracensis	Tremont, Porter Co., Indiana 21.V.47. O. Park
	Lasius aphidicola	Lakeside, Berrien Co., Michigan 16.VIII.47. L. Jones
ionae	*Lasius americanus*	Schwarz, 1890
lineaticollis	*Formica subsericea*	Wickham, 1894
monstrosus	*Lasius claviger*	Schwarz, 1890
	Lasius interjectus	Schwarz, 1890
	Amblyopone serrata	Schwarz, 1890
	With ants, host not specified	Blatchley, 1910
	With ants, host not specified	Leng and Nicolay, in Leonard, 1928
	Lasius aphidicola	Park, 1935a
	Lasius aphidicola	Urbana, Champaign Co., Illinois 22.V.34. O. Park
	Lasius aphidicola	Crothersville, Jackson Co., Indiana 20.IV.35. O. Park
	? *Lasius aphidicola*	Plummers Id., Maryland 1.V.14.
riparius	*Aphaenogaster tennesseensis*	Park, 1935a
scabriceps	*Formica subsericea*	Wickham, 1896
	Formica exsectoides	Leng and Nicolay, in Leonard, 1928
	Aphaenogaster tennesseensis	Park, 1935a
	Aphaenogaster fulva	Urbana, Champaign Co. Illinois 22.V.34. O Park
schaumi	*Lasius aphidicola*	Park, 1935a
	Aphaenogaster tennesseensis	Park, 1935a
zephyrinus	*Formica rufa*	Mann, 1911

Of special interest in this table is the fact that of the forty-one species of *Batrisodes* east of the Rocky Mountains, twelve, or twenty-nine per cent, are known to be associated with ants to some extent.

The most abundant, and most widely distributed species (*globosus*) is recorded with the largest number of known hosts.

Of the latter, the light-yellow species and subspecies of *Lasius* (e.g. *umbratus mixtus aphidicola* and allies) have societies that are either most easily penetrated, or are the most stimulating to *Batrisodes*. Such ants have populous colonies, of a pleasing aromatic odor, generally tend

aphids, and excavate soft, decayed logs on the floors of deciduous forest communities. *Lasius niger americanus* is even more widely distributed, frequently tends aphids, and is another common host. The large colonies of the mound-builders (*Formica exsectoides* and *ulkei*) are apparently less easily penetrated, possibly as a consequence of their larger worker size and more obvious ability to defend the nest.

Despite this defense, such mound-builders have quite an array of inquilines, of several categories of ecological association (Park, 1929, 1935b), but do not appear to harbor many species of *Batrisodes*.

Aphaenogaster fulva, in well-decayed logs, and *A. tennesseensis*, usually in harder wood, may have extensive colonies and are the hosts of at least three species of *Batrisodes*.

The percentage of occurrence of these pselaphids with ants indicates a definite myrmecophilous potential of the genus, in the area under discussion. More intensive collecting should serve to strengthen, rather than detract from, this assertion. With this in mind, an examination of the small amount of data on the requirements and behavior of the genus is desirable.

Food. The species of *Batrisodes*, as far as is known, are carnivorous Within this category, the beetles exhibit a variety of response: cannibalism, predatism, and scavengerism.

Under natural conditions, the facultative *globosus* has been observed, under a hand lens, feeding upon mold mites of the families Hoplodermatidae and Oribatidae (Pl. VIII). This mite-devouring proclivity is fairly general for the family (Park, 1947). Denny (1825) gave the food of British pselaphids as mites, in moist habitats. In laboratory containers the same activity may be observed under higher magnification.

Batrisodes globosus also attacks earthworms (Park, 1929). When this species is isolated with earthworms in artificial nests, the beetles bite at the worm's integument, and eat the secreted slime. They bite and gnaw the wounds, and scrape up exuded body fluids avidly. The prothoracic tarsi are planted on the worm, the mandibles bite into the tissues, and the head is pulled upwards while the legs are braced against the writhing worm.

If entangled in the mucus, the beetles eventually free themselves by extricating one tarsus after another.

The twisting of the worm does not deter the beetles, and as many as three *globosus* per square centimeter of worm surface have been noted feeding under laboratory conditions. Nevertheless, if one of the beetles comes too close to another under these circumstances, it will pause in feeding long enough to bite at the intruder, and usually drives the latter away.

This species may feed on earthworms for as long as thirty minutes. After feeding the beetles clean their antennae and forelegs. Usually one antenna at a time is thrust from above between the slightly gaping mandibles. Then it is pushed and pulled back and forth, in part by its own muscles, but also by the forelegs which may assist in pushing the antenna upward. After the antennae have been cleaned they are withdrawn and each prothoracic leg is thrust between the mandibles in turn, where it is drawn rapidly back and forth, as far as the basal third of the tibia.

After such cleaning behavior they may return to eating, or not.

In addition to mold mites and earthworms, *globosus* will attack members of its own species. This cannibalism can be forced upon them if several beetles are isolated in a moist petri dish without food. Under these circumstances, the first individual to weaken and die is attacked by the others. These latter bite and scrape the integuments, especially the relatively thin articular membranes.

These few data suggest that members of this genus, when not in the nests of ants, lead a free-living, predaceous life, devouring any living animal that can be attacked and injured, as well as feeding upon animals recently killed. Consequently, their foods can be drawn from the teeming life of the litter and mold of the forest floor stratum.

The second important habitat, the ant society, offers at least as many, if not more possibilities of obtaining the proper foods with the minimum danger. This is especially so if the species is tolerated by the host workers.

As suggested earlier, the species of *Batrisodes* are tolerated inmates of the ant society, where they have been investigated.

When a nest is opened in the field, the beetles and ants attempt to reach deeper galleries, or take cover under pieces of the nest without interfering with each other.

In the laboratory, many years of observation have confirmed the synoekete status of *globosus, frontalis* and *monstrosus.* When a host worker comes into contact with a beetle, the latter often crouches down or walks rapidly off. The ant usually does no more than pause and twirl her antennae. On rarer occasions, an ant has been seen to bite at the beetle. The latter easily slides out of the grasp of the ant's mandibles, and the ant does not continue the attack.

If *globosus* is confined in narrow quarters with several workers of *Formica ulkei* these repeated attacks may be observed; the same species of beetle taken with *Lasius aphidicola,* confined in the same way, is not as apt to be bitten. Nevertheless, even with *ulkei* the beetles appear able to escape death, and the differential response of the host is to be expected. In one case a *globosus* was placed with several *ulkei* workers in a small

petri dish without food. Over night the beetle was caught and dismembered.

The general bearing of such observations and experiments suggests that *Batrisodes* can penetrate the ant society, and live a relatively unmolested life in its spacious galleries, where food, and protection from enemies, other than rare attacks by the host, offer optimal conditions.

In ant nests these beetles feed on a variety of foods. The nests usually harbor numerous mites, many of which are ectoparasitic. A common acarid is the large, light brown gamasid (*Antennophorus wasmanni* Wheeler) that rides about on the workers of *Lasius aphidicola* (Park, 1932a). These and similar forms are natural foods of pselphids, whether in floor mold or specialized for life in the ant society.

Davey (1945) reports that pselaphids destroy mites in ant nests, and remove mites from the ant's integument, thus performing an indirect service to the ant society.

Such a service tends to balance the scales, since *Batrisodes globosus* and *frontalis,* at least, are known to feed upon ant larvae.

These tolerated beetles are to be expected to continue their natural carnivorism in the ant nest. *Batrisodes globosus* did not take sugar syrup provided in experimental nests (Park, 1929), and often was observed to walk through the solution, or become caught in it, without taking any with the mouth-parts.

On the other hand, *globosus* feeds on the larvae of *Lasius niger americanus* (Park, 1932b). Living host larvae, larvae crushed and fresh, and dead and discolored larvae, were experimentally offered to this species of pselaphid. All were attacked and eaten. The beetles did not show a tendency to eat every day. Occasionally a beetle would eat on two consecutive days. Generally they fed every other day. Duration of feeding varied from desultory biting to continuous eating for ten minutes. Since the dead and discolored ant larvae were also eaten, it is noteworthy to point out that scavengerism may also be of service in the ant society, and, with the destruction of mites, tend to offset the negative rôle of *globosus.*

Recently, unpublished data on *Batrisodes frontalis* have been analysed. This species was observed in experimental nests with its host, *Lasius aphidicola,* and an attempt was made to determine the amount of food consumed, and the time of eating.

The average amount of food consumed was one host larva per pselaphid per twenty-four hours, and the beetles generally ate the larvae at night, between 5:00 P.M. and midnight. The bearing of this will be noted later.

Donisthorpe (1927) observed the palaearctic *Batrisodes delaportei* carrying the immature larvae of *Acanthomyops brunneus* between their mandibles, and we may conclude that the feeding on ant larvae, dead or

alive, is a normal response for species that inhabit ant nests. Here again, much more information is needed, and at present it appears that the feeding habits of the species are not appreciably different, whether in forest mold or in the ant nest; and that the host's society is harmed by consumption of the brood, and benefited by the eating of nest mites as well as scavengerism.

Enemies. The only definite data on enemies of *Batrisodes* concerns the record of *hairstoni* in the stomach of the red-backed salamander, *Plethodon cinereus,* discussed previously. Since several *Aphaenogaster* workers, and a gamasid mite, were included in the stomach contents, the assumption is that the salamander was feeding upon an ant colony, and the beetle taken along with the other nest inhabitants.

On the other hand, this salamander is insectivorous (Jameson, 1944), and is characteristic of rich forests, where it inhabits the floor mold. Therefore, the red-backed salamander in particular, and forest-dwelling salamanders, toads and frogs in general, are to be considered potential predators of *Batrisodes,* the species of which inhabit forest floor mold and ant nests.

Whereas this salamander datum serves to complete the food-chain between the food of *Batrisodes* and its enemies, it is but a single record and the entire problem needs further study.

Of particular interest would be an examination of the stomach contents of *Plethodon cinereus* and its allies for possible additional records of their feeding upon pselaphids.

Direct experimental confinement of these amphibians with individuals of *Batrisodes* should yield suggestive data, not only as to whether the pselaphids would be eaten, but the time of the day-night cycle any feeding occurred. The red-backed salamander is known to be predominantly nocturnal. The species is described as strictly nocturnal by Piersol (1910, p. 470). The salamanders pass the day beneath stones and log mold, and tend to become active in northeastern Ohio beech-maple forests by 8:45 P.M. (Park, Lockett and Myers, 1931, p. 718). In moist, closed petri dishes this species of salamander demonstrated a strong preference for low light intensity during the daytime (Test, 1946).

Apparently these data show a positive correlation between the time of activity of the predator and its prey.

Response to Moisture. Groups of *Batrisodes globosus* have been tested in petri dishes with respect to substrate moisture and relative humidity (Park, 1929). In closed dishes with moist filter paper floors, with light and temperature relatively constant, the activity and length of life was contrasted with that of controls in which the filter paper floors were dry.

The beetles wander over the moist filter paper, but as the water gradually evaporates, they restrict their activities to the moister areas. Eventually, the pselaphids crowd together in a compact mass on the moist spot, and die there as it dries out.

This response, frequently repeated under controlled conditions, suggests that in its naturally moist habitats this species (and presumably the whole genus) tends to wander freely, and that it is restricted to such habitats by a positive response to a high relative humidity.

Response to Light. Both sexes of *globosus* were tested for their phototropism (Park, 1929). With temperature and relative humidity relatively constant, the beetles were exposed to light of 120 foot-candles and darkness. Under experimental conditions, they averaged sixty per cent photonegative.

This response, in combination with the positive response to high relative humidity, would tend to restrict the population to the moist, darkened recesses of the forest floor or the galleries of the ant nest.

Activity. Species of *Batrisodes* have a regular, unhurried walk amidst the hurry of the worker ants. Pselaphids in ant nests in general tend to move more slowly than their hosts. Since such species are either synoeketes or symphiles, and tolerated or actively attended by their hosts, there appears to be an indirect correlation between their rate of locomotion and their place in the ant society (Park, 1947). That is, actively tended symphiles (clavigerids) move more slowly than the tolerated synoeketes (*Batrisodes*).

For example, a common host, *Lasius aphidicola,* moves over a smooth surface at between 75 and 150 centimeters per minute, and *Batrisodes frontalis* and *B. schaumi* at between 40 and 125 centimeters per minute (Park, 1947). In another case, the larger *Formica ulkei* workers moved at between 150 to 200 centimeters per minute, and *Batrisodes globosus* moved at between 65 and 80 centimeters per minute (Park, 1929). The rate of travel was subject to variation depending upon the experimental conditions but the slower average speed of the beetles would tend to place a positive survival value in the nest upon agility and adjustments other than speed.

Batrisodes, in common with the great majority of pselaphids, tend to be nocturnal, or more properly crepuscular. Their greatest period of activity, dusk to midnight, coincides with the part of the twenty-four hour cycle that has both a high relative humidity and a low light intensity. These two conditions probably regulate and reenforce their activity pattern. *Batrisodes globosus* may be taken in flight at dusk, and the dusk flight of several species was known to LeConte (1850 p. 94).

Summing up, the species of *Batrisodes* occupy two chief habitats, namely, the floor mold of forests and the nests of ants. They are carnivorous, and exhibit active predatism and scavengerism. Their chief foods include mites, both in litter (Oribatidae, Hoplodermatidae) and ant nests (Gamasidae), earthworms, and the brood of ants. The species tend to be positive to high relative humidity and low light intensity. They tend to be crepuscular in activity, and may fly at dusk. These several adjustments and responses serve to more or less restrict the populations to their natural habitats

THE WESTERN OUTLIERS OF EASTERN POPULATIONS

Brendel and Wickham (1890) separated the majority of the then-known species of *Batrisodes* into two portions, one composed of "Pacific coast species," and one of "Eastern species."

Since that time the literature has continued to emphasize this geographic separation (Casey, 1893, p. 469, 1908, p. 260; Bowman, 1934, p. 57). The author was similarly converted to this pleasantly simple situation.

The realities appear to be more complex.

Wickham (1898) reported taking *Batrisodes frontalis* in the nest of *Lasius claviger*, and *Batrisodes globosus* in the nest of *Camponotus herculeanus* at Colorado Springs, Colorado.

Both *globosus* and *frontalis* are typical of the eastern fauna and the Wickham records should have warned us that certain species that were distributed through the deciduous forest biome had western outliers as well.

While studying a part of the Wickham collection, deposited at the Chicago Natural History Museum, these Colorado specimens were found and the identifications verified. Subsequently, a pair of *globosus,* collected in recent years at Boulder, Colorado, was sent to me for identification by the University of Colorado Museum. Finally, a specimen of *nigricans* was found, in the Frank J. Psota collection. from Denver, Colorado.

These several specimens are examined in Table II, page 118.

From this table certain interesting observations and inferences are possible. (1) All of the *frontalis* and *globosus* specimens were taken with ants. This is interesting in connection with the LeConte Hypothesis, discussed presently. (2) Where these ants are named, they are either identical with, or closely allied to, hosts that normally harbor these species of *Batrisodes* in the eastern range of the pselaphids. (3) Where altitudes are given, the records indicate that the pselaphids were taken

TABLE II

WESTERN OUTLIERS OF EASTERN SPECIES

Species of *Batrisodes*	Eastern range of species	Data on western specimens	Place of deposition
frontalis	Olmsted County, Minnesota southward through Johnson County, Iowa, Missouri and Douglas County, Kansas; eastward through Wisconsin and Manitoba on the north, and Hamilton County, Ohio on the south, into Pensylvania.	♂ Colorado Springs, El Paso County, Colorado. H. F. Wickham. June 15-30, 1896. 6000-7000 feet with *Lasius claviger.*	Chicago Natural History Museum
		♀ Buena Vista, Chaffee County, Colorado. H. F. Wickham. July 1-6, 1896. 7900-8000 feet.	Chicago Natural History Museum
globosus	On the north from Quebec, Vermont and Massachusetts west into Vilas County, Wisconsin; south through Johnson County Iowa, Douglas and Montgomery Counties, Kansas, Washington County, Arkansas to Texes and Natchitoches Parish, Louisiana; eastward into central Florida.	♂ Colorado Springs El Paso County, Colorado. H. F. Wickham. June 15-30, 1896. 6000-7000 feet with ants.	Chicago Natural History Museum
		♂, ♀ Boulder, Boulder County, Colorado. M. T. James. May 13, 1933. with ants.	University of Colorado Museum
nigricans	Long Island, New York south through Ocean County, New Jersey, into South Carolina.	♂ Denver, Denver County, Colorado. F. J. Psota collection.	Chicago Natural History Museum

not higher than the aspen-birch stratum, and probably in a richer deciduous forest stratum with a developed floor mold.

Several possible explanations are available to account for the Colorado island of eastern *Batrisodes,* but none of them are firmly established. Too little field work is the major handicap

(1) That *frontalis* and *globosus* formerly occupied a continuous range from the Atlantic seaboard westward, through the deciduous forest biome and grass land biome, up the eastern slope of the Rocky Mountains to at least 8000 feet, and have since become restricted to the deciduous forest. I do not give this view serious consideration as the known ecology of these species does not suggest such tolerance to differential amounts of moisture, and there is no parallel zoögeographic material in other animals, save those that have become adjusted to the society of man *per se.*

(2) That *frontalis* and *globosus,* both facultative synoeketes, have moved into Colorado, protected by the dark, moist, food-rich *milieu* of a series of ecologically equivalent host ants:

(a) westward through Kansas and Nebraska (but if this is so where are the records?), or

(b) north and northwest, through central Manitoba, following timbered fringes through Saskatchewan and Alberta, then southeastward along the Rocky Mountains, at altitudes where their forest floor adjustments could be utilized (Pl. IX).

This last view presupposes that future collecting should yield records along the line of dispersal. So far there are none known to the author. Despite the seemingly long way around, this last possibility has some support in parallel zoögeography. For example, Grobman (1941) has shown that the green snake, *Opheodrys vernalis,* has a somewhat similar, although shorter, arcuate dispersal pattern.

Whatever the explanation, the interested reader may well imagine with what attention the Colorado material was examined for subspecific criteria. There were very slight differences in the *frontalis* and *globosus* specimens, but both have large eastern populations, the external anatomy of which is subject to considerable variation, in both sexes. Without more specimens, and with no data on intergradation, the question of subspeciation was shelved for future consideration.

The single *nigricans* record is startling. This species is not common in collections, and appears to have a limited distribution along the Atlantic seaboard. If the locality record from Colorado is authentic, the distribution pattern is more difficult to understand than for *frontalis* and *globosus.*

Summing up, there appear to be at least four *Batrisodes* faunas in North America. (1) The truly western or Pacific coastal fauna of eleven species, from British Columbia southward through California and eastward into Nevada and Idaho. (2) A Colorado fauna of outliers of eastern species. (3) A large, complex fauna of forty-one species that occupies the deciduous forests in large part, and the transitional coniferous-deciduous forests on the north and the grassland-forest transition on the west. (4) An Alabama cavernicolous fauna.

A possible integration is suggested in the following section.

BEARING OF THE LE CONTE HYPOTHESIS ON THE ZOOGEOGRAPHY OF THE GENUS, AND GENERAL OBSERVATIONS ON PSELAPHIDAE

Determination of center of origin and paths of dispersal are of fundamental importance in a study of the central biological problem of evolution. In groups where there is little or no palaeontological data, as in Pselaphidae, the conclusions are often unsatisfactory. Nevertheless, the present distribution of species, and their ecology throws some light on the situation in *Batrisodes*.

In his early monograph on the pselaphids of the United States, John L. LeConte (1850, p. 94) stated:

"In the Northern States an individual of this genus [*Batrisodes*] is scarcely ever seen apart from a colony of ants, but in the South, they are quite frequently found under the bark of trees."

This important ecological generalization has remained insufficiently recognized for nearly a century. It is here proposed that it be termed the LeConte Hypothesis.

To the best of my knowledge, this hypothesis is sound. Species of *Batrisodes* may occur in ant nests in southern habitats, and others may occur apart from ants in northern habitats, but the frequency of occurrence in ant nests increases steadily from southern to northern localities.

Turning from the Nearctic to the Palaearctic and Oriental Regions, we have a similar situation. The French expert, Achillé Raffray (1908, p. 158) states with respect to *Batrisodes*:

"Parmi les espèces d'Europe, plusiers sont myrméophiles; en Indo-Malaisie les *Batrisodes* habitent surtout dans les détritus végétaux et les feuilles mortes."

These similar views suggest that the LeConte Hypothesis has global application, and this being the case there must be some fundamental reason for its applicability.

The answer is found in a study of the tolerances of the populations to the critical variation of natural influences in their environments. Where

species have been studied, they have been found to feed upon the myriads of small, chiefly herbivorous mites and insects that infest the floor mold of forests. Consequently they are indirectly restricted to vegetable debris. They are also relatively photonegative, and positive for a relatively high amount of moisture. All of these things combine to restrict them to forest floors, or their equivalents.

The complex society of ants is an equivalent in general terms, the relatively humid, dark nest chambers and galleries being not too dissimilar from log and leaf mold. The penetration of such habitats as ant nests would require adjustment to the host, and the substitution of gamasoid mites and ant larvae for oribatoid mites and other mold-inhabiting animals. The genus has made this adjustment. The species inhabiting ant nests are synoeketes, and are known to feed on gamasoid mites and the ant brood where they have been studied.

Consequently, it is probable that the species of *Batrisodes* tend to invade the societies of ants more frequently in the North Temperate areas, and so gain an amelioration of their immediate environment that would not be possible if they were free-living inhabitants of floor mold. Probably many factors are involved, such as the lower mean temperature, more prolonged winter, with its physiologically inaccessible moisture, smaller amount of food per unit area, and the less uniform length of day and night.

If this explanation of the LeConte Hypothesis is tenable, then its importance can be realized on a broader zoögeographic basis for what has been said in favor of southern portions of the North Temperate and subtropical areas is even more obvious for the Tropical Zone.

We agree with Raffray (1908, p. 158) that this is a genus having its center of dispersal in southeastern Asia. Other things being more or less equal, areas of greatest taxonomic density would seem to be those of historical importance. The following table demonstrates the dispersal pattern.

TABLE III

DISTRIBUTION OF BATRISODES BY REGIONS

Region	Number of species	Percentage of species
Palaearctic	41	18.7
Nearctic	52	24.0
Ethiopian	4	1.8
Neotropical	0	0.0
Oriental	83	38.2
Australian	34	16.0
Totals	214	98.7

From this table it will be noted that about four-tenths of the known species of *Batrisodes* are from the relatively poorly known Oriental Region; that from this center the relatively well known peripheral areas have much smaller regional faunas. No species is known to inhabit two regions. This distribution is suggested in Plate X.

Such a hypothetical Oriental center is not only in accord with the area of highest taxonomic density but is justified by the abundance of species in this area that do not live with ants.

In the plate of *Batrisodes* distribution there are several points of interest. Of notable importance is the relatively high peripheral density of southeastern North America paralleling the high density of southeastern Asia. This situation is also found in several other groups of organisms.

One hypothetical dispersal route is through the East Indies into New Guinea and Australia. It is interesting in this regard to note that in Australia it is the eastern forested areas that have a high taxonomic density. In general the arid areas of the world, where forests, vegetable mold and presumably mold mites are absent or poorly developed, are areas with few or no species of *Batrisodes*.

Two regions, the Neotropical and the Ethiopian, are impoverished. The Neotropical Region lacks any species of *Batrisodes*. The absence of the genus from this area has been discussed (Raffray, 1923, 1924; Park, 1942, p. 248). There are several explanations available. (1) The absence of the genus may be a consequence of the historical factor; that is, the genus has not had sufficient time to spread southward from the Nearctic. (2) This dispersal may be blocked at the present time by the relatively great aridity of southwestern United States and northern Mexico. (3) Southward dispersal may be retarded or blocked by biotic competition of the large, endemic, and presumably long-established and well-adjusted neotropical batrisine fauna.[11] (4) The genus may have entered the neotropical forests in the past and have evolved as the endemic genus *Iteticus*. The morphological differences between *Batrisodes* and

[11] A complementary situation is found in the genus *Arthmius* and its close allies, *Syrbatus* and *Syrmocerus*. *Arthmius* and *Syrmocerus* are restricted to the Western Hemisphere; *Syrbatus* has three species in Africa. With the exception of these three species, these genera are overwhelmingly neotropical. *Syrbatus* has 30 neotropical species and *Syrmocerus* has 5 neotropical species but neither genus is known from the Nearctic. *Arthmius* has 99 neotropical and 5 nearctic species. Consequently these 134 arthmioid species appear to have arisen in the Neotropical Region and to have penetrated the Nearctic slowly and with difficulty. The other neotropical batrisine genera are also endemic, with the exception of one doubtful locality citation from Louisiana (Park, 1942, p. 214-259).

Iteticus are not too great to preclude such an assumption. Again, the lack of reliable palaeontological material and inadequate data on larval stages hamper speculation on the past history of pselaphids.

The Ethiopian Region has four species of the genus. This paucity may be interpreted as the result of the historical factor, but such an explanation is not too probable on general grounds. The chief difficulty to such a view is the large ignorance concerning pselaphids of Africa.

It is interesting to contrast the distribution of *Batrisodes* with the distribution of pselaphids as a whole. General data are assembled in Tables IV and V.[12]

Of the twenty tribes listed (Table IV), seven are either endemic or restricted almost wholly to one region. Of these seven restricted tribes, one (Schistodactylini) is Australian and four (Jubinini, Metopiini, Arhytodini, Attapseniini) are Neotropical. All seven are very small with the exception of Jubinini which is relatively of very modest size. The large tribes (Euplectini, Brachyglutini, Batrisini, Tychini, Tyrini) on the other hand are distributed through all six major zoögeographic regions. This suggests that the larger tribes are more ancient and have had more time to spread whereas the seven endemic or restricted tribes are more recent and have evolved from more ancient stock. In this connection it is of interest to note that two of the three peripheral portions of the land mass, e.g. Australian and Neotropical, contain five out of seven restricted tribes. Hence the terminal faunas, as we know them, tend to be more endemic than those of more central areas. Comparisons are made (Table V) that substantiate this point. This analysis shows that (1) there is a large and general similarity between the terminal faunas as contrasted with their nearest areas, and (2) that the pselaphid fauna of the Neotropical Region is much more endemic than that of the Australian. Future collecting should serve to strengthen rather than weaken these conclusions.

We have insufficient data as yet to map specific routes of dispersal or discuss special centers of evolution but several lines of evidence suggest a tentative and speculative center of dispersal in the Oriental Region (Pl. XI). The overwhelming numbers of recent species are restricted to tropical and subtropical areas. General food and habitat requirements of the family suggest a relatively warm, relatively well-forested area. The LeConte Hypothesis suggests such an area. Eleven out of twenty tribes, including all of the large ones, are present in the Oriental Region. This region is placed strategically with reference to dispersal over the East Indies into the Australian Region, northeastward over the Behring "bridge" into the Nearctic-Neotropical, northwestward into the Palaearctic and westward into the Ethiopian Region.

[12] Table V should have included an analysis of the relationship between the Palaearctic Region and the third terminal fauna, that of the Ethiopian Region. This is not feasible at present since so little is known relatively concerning the African fauna. It is the poorest known region with respect to pselaphids.

TABLE IV

SPECIES, SUBSPECIES, AND VARIETIES OF PSELAPHIDAE BY TRIBES AND ZOOGEOGRAPHIC REGIONS

	TRIBES[13]	PALALARCTIC	ETHIOPIAN	ORIENTAL	AUSTRALIAN	NEARCTIC	NEOTROPICAL	ANTARCTIC	TRIBE TOTALS
1.	Faronini	16	3	0	151	10	4	0	184
2.	Pyxidicerini	0	14	30	3	0	6	0	53
3.	Jubinini	0	0	0	0	1	77	0	78
4.	Mirini	2	0	0	0	0	0	0	2
5.	Euplectini[14]	178	84	54	226	131	128	1[15]	802
6.	Brachyglutini	118	47	121	303	113	299	0	1001
7.	Metopiini	0	0	0	0	0	22	0	22
8.	Batrisini	117	47	233	63	59	190	0	709
9.	Tychini	355	42	23	30	22	33	0	505
10.	Goniacerini	0	9	0	0	0	10	0	19
11.	Cyathigerini	0	0	37	6	0	0	0	43
12.	Pselaphini	55	9	35	65	5	9	0	178
13.	Holozodini	0	1	0	0	1	1	0	3
14.	Hybocephalini	1	3	25	1	0	3	0	33
15.	Ctenistini	55	36	19	27	19	12	0	168
16.	Schistodactylini	0	0	0	5	0	0	0	5
17.	Tyrini	15	46	100	117	14	136	0	428
18.	Arhytodini	0	0	0	0	0	11	0	11
19.	Attapseniini	0	0	0	0	0	2	0	2
20.	Clavigerini	40	56	14	61	9	22	0	202
	Region Totals	952	397	691	1058	384	965	1	4448

[13] Not including two tribes: the Dimerini, formerly placed in Pselaphidae, but probably belongs in Staphylinidae; Mayetini, formerly placed in Staphylinidae, but belongs in Pselaphidae.

[14] Euplectini *sensu latiore*, including Euplectini and Trichonychini of authors.

[15] *Pseudeuplectus antarcticus* Enderlein, from Crozet Island, in the Indian Ocean, between Cape of Good Hope and Australia, at approximately 50 degrees East Longitude and 50 degrees South Latitude.

TABLE V

COMPARISONS OF TERMINAL PSELAPHID FAUNAS

Australian-Oriental Comparison

	Oriental		Australian	
Total genera	142	100%	124	100%
Endemic genera	91	64%	90	73%
Genera common to both the Oriental and the Australian Regions	31	21%	31	25%
Non-endemic genera not found in the adjacent region	20	14%	3	2%
Total species	691		1058	
Endemic species	689		1056	
Species common to both the Oriental and the Australian Regions	2		2	

Neotropical-Nearctic Comparison

	Nearctic		Neotropical	
Total genera	65	100%	147	100%
Endemic genera	32	49%	126	85%
Genera common to both the Neotropical and the Nearctic Regions	21	32%	21	15%
Non-endemic genera not found in the adjacent region	12	19%	0	0%
Total species	384		965	
Endemic species	384		965	
Species common to both the Neotropical and the Nearctic Regions	0		0	

This plate does not suggest a single dispersal. Probably there have been many dispersals of separate components over long periods of time, as well as numerous secondary centers of evolution and dispersal (Raffray. 1923, 1924). At present at least four areas are known to have high taxonomic densities with reference to adjacent territory; viz., Australian Region, Neotropical Region, southern European-Balkan, and Madagascar

Certainly four influences have had an important directional effect: (1) suitable past tropical and temperate climates; (2) the presence of vegetable mold, and indirectly of forests; (3) the adjustment to the complex societies of ants; (4) suitable intercontinental connections. The operation of these influences suggests a long period of evolution but lack of adequate palaeontological data renders any more exact assumption speculative. In view of the large and highly endemic pselaphid faunas of the Australian and Neotropical Regions, the initial outlines of the present dispersal pattern must have been complete not later than early Tertiary, and possibly much earlier. Prior to this period a long evolution from staphylinoid ancestors (Park, 1942) must have occurred.

ABSTRACT

The external anatomy of *Batrisodes* is discussed and illustrated with special emphasis upon the taxonomy of the Nearctic fauna.

Keys are given for males and females of North American species distributed eastward of the Rocky Mountains. Each of these species popu lations is then diagnosed and their known distribution described.

Three additional synonyms are reported. These are *curvatus* Sander son, a synonym of *confinis* (LeConte); *harringtoni* Casey, a synonym of *scabriceps* (LeConte); *triangulifer* (Brendel), a synonym of *nigricans* (LeConte).

Four new species of *Batrisodes* and one new variety are described These are *sandersoni* (Illinois), *rossi* (Illinois), *hairstoni* (Indiana), *schaefferi* (North Carolina), and *striatus psotai* (Illinois).

Nearctic species of the genus are separated into nine groups.

The general ecology of *Batrisodes* is discussed, with emphasis upon habitat, integration into the societies of ants, food and feeding behavior enemies, including the first record of a species of *Batrisodes* found in the stomach of a red-backed salamander, response to moisture, response to light intensity, activity, and the bearing of these ecological adjustments upon dispersal.

Three species typical of the deciduous forests of eastern North America (*globosus, frontalis,* and *nigricans*) also occupy nests of certain ants in eastern Colorado. These western outliers of eastern population are discussed in terms of possible dispersal.

LeConte (1850) noted that in the United States species of *Batrisodes* tended to occupy the nests of ants more frequently in the northern portions of their ranges than in the southern portions. This general view is elevated to the LeConte Hypothesis, and its bearing is discussed with respect to (a) the distribution of the genus *Batrisodes,* and to (b) the general distribution of Pselaphidae. Important influences in past dispersals are given as (1) a past temperate to tropical climate, (2) presence of vegetable mold, and inferentially of forests and an abundance of food such as free-living mold mites, (3) suitable intercontinental connections The family is examined briefly in terms of tribes and of zoögeographic regions, and terminal faunas are contrasted with their nearest regions.

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    - C. subocular field.
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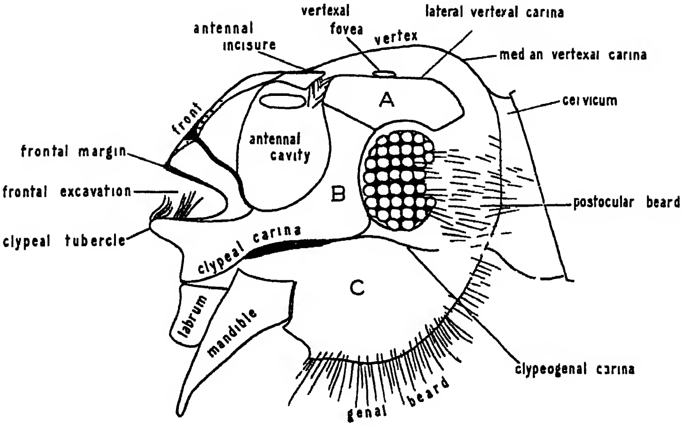
3. *bistriatus*, male, left lateral view of head.


vertexal fovea
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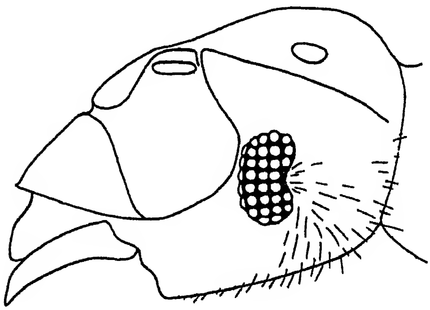

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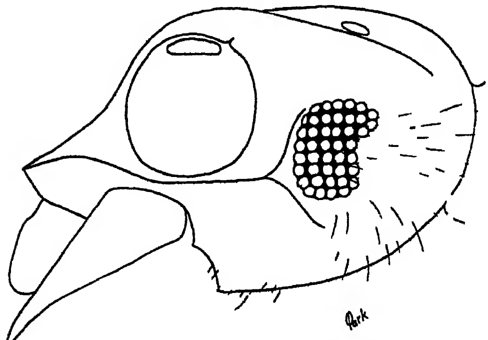
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Plate II

1. *uncicornis,* male, antennal segments IX, X and XI
2 *riparius*, male, antennal segments IX, X and XI
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12 *schmitti*, male, antennal segments I and II.
13. *scabriceps,* male, antennal segments X and XI.

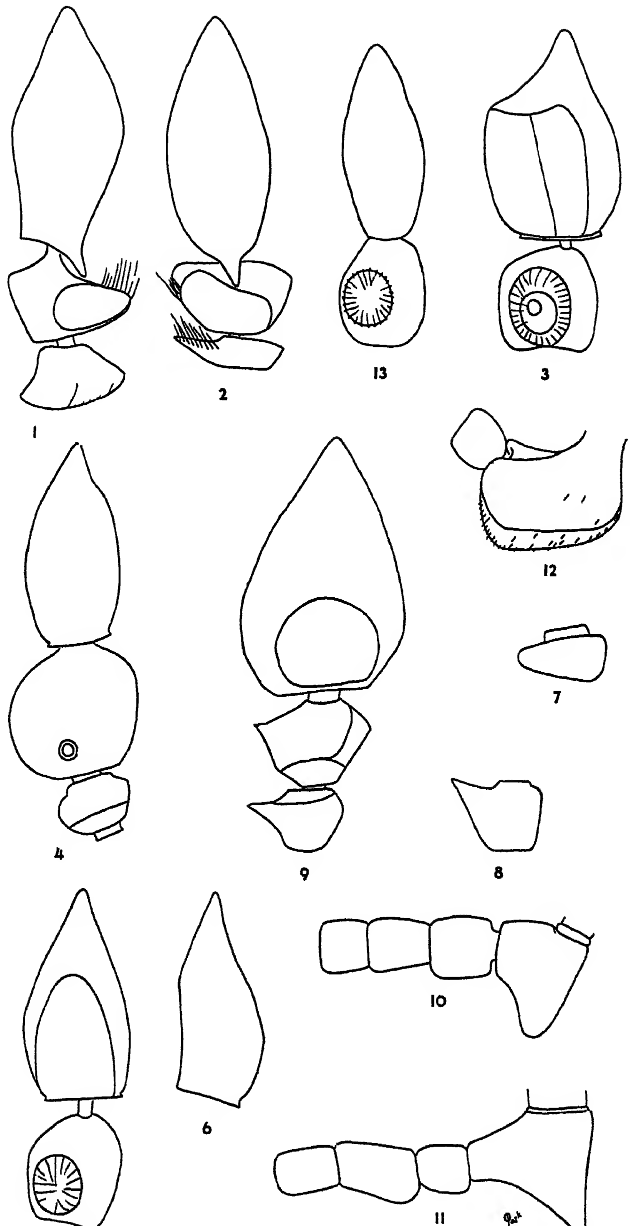
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PLATE III

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6. *cavicornis*, male, apex of mesothoracic tibia and abnormal type of tarsus.
7. *monstrosus*, male, prothoracic tibia.
8. *ionae*, male, mesothoracic femur.
9. *punctifrons*, male, prothoracic tarsal claws.
10. *furcatus*, male, prothoracic tarsal claws.
11. *frontalis*, male, prothoracic tarsal claws.
12. *punctifrons*, male, apex of mesothoracic tibia and abnormal type of tarsus.

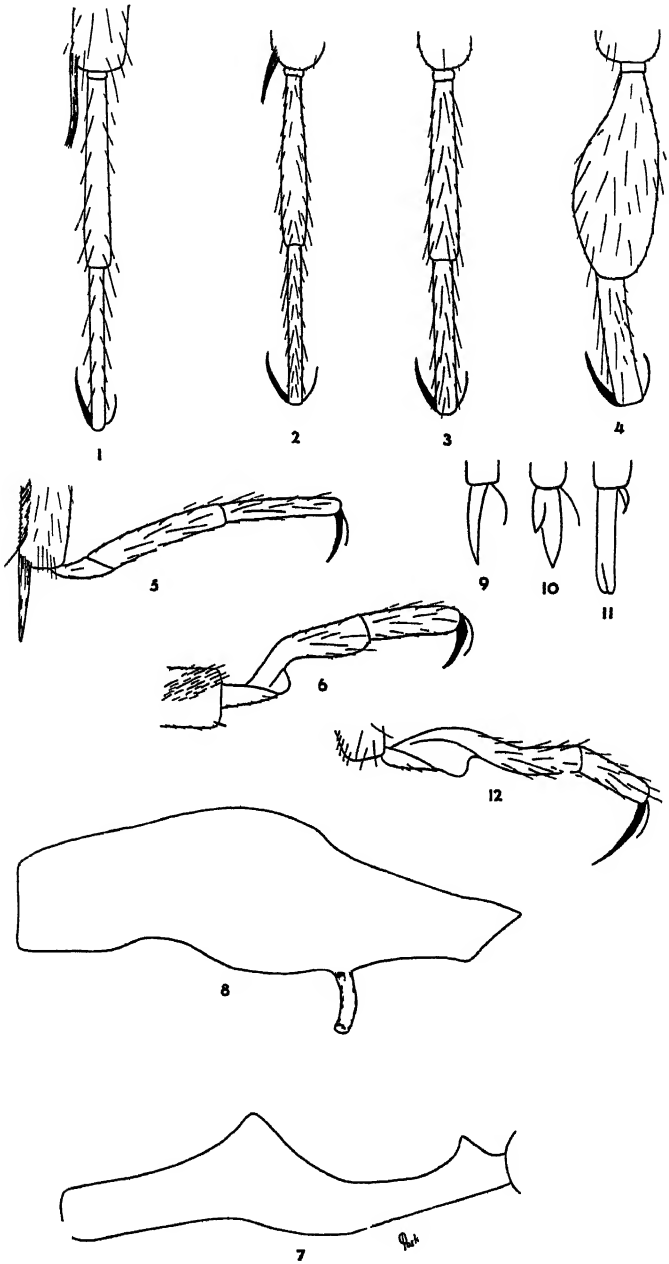
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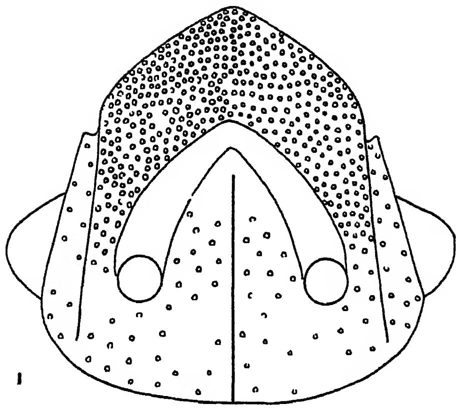
PLATE IV

1. *globosus*, male, dorsal view of head.
2. *furcatus*, male, dorsal view of head.
3. *spretus*, male, dorsal view of head.



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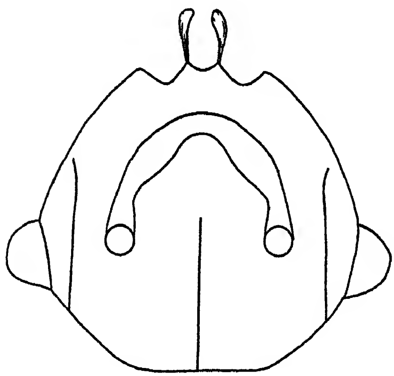

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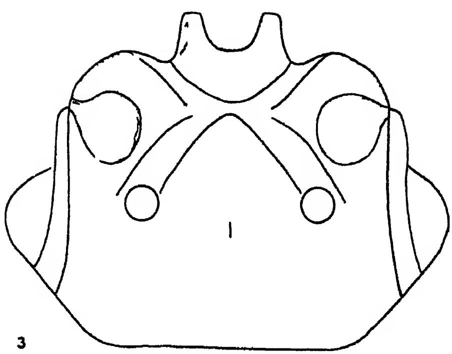

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PLATE V

1 *lineaticollis* and *bistriatus*, males, fifth sternite.

2 *cartwrighti*, male, fifth sternite

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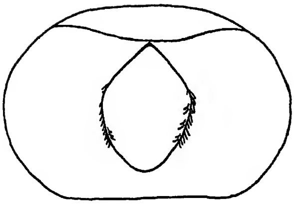
8. *punctifrons*, male, setae of frontal declivity, greatly magnified.

9. *appalachianus*, male, setae of frontal declivity, greatly magnified.



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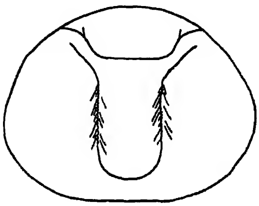

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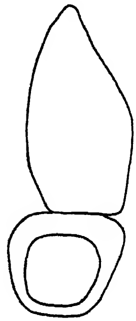

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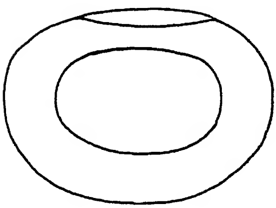

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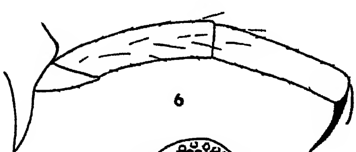

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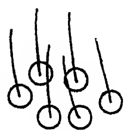

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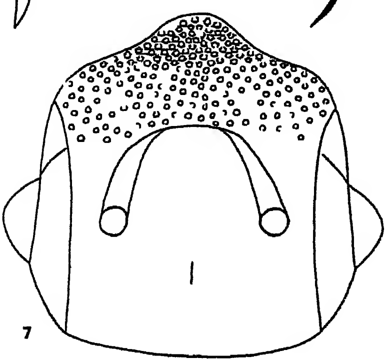

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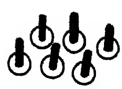
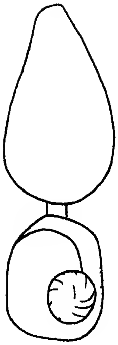


8

PLATE VI

1 *sinuatifrons*, male, antennal segments X and XI.
2. *rossi*, male, antennal segments X and XI.
3 *sandersoni*, female, left lateral pronotal margin.
4. *cavicrus*, female, left lateral pronotal margin.
5. *hairstoni*, male, antennal segments X and XI.
6. *schaefferi*, male, mesothoracic tarsus
7. *spretus*, male, antennal segments X and XI.
8. *scabriceps*, male, dorsal view of head.



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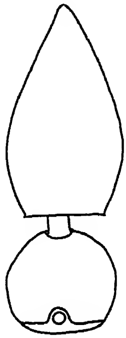

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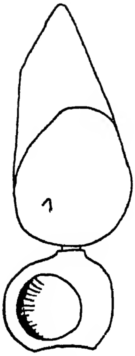

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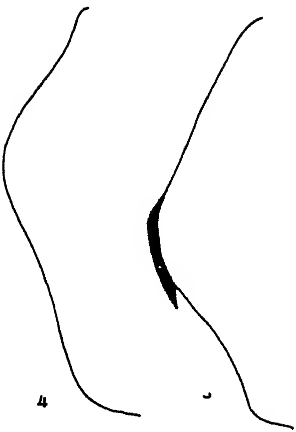

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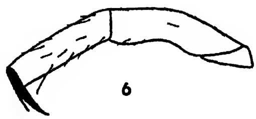

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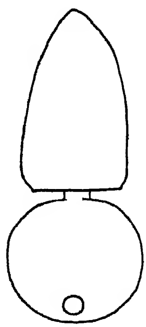

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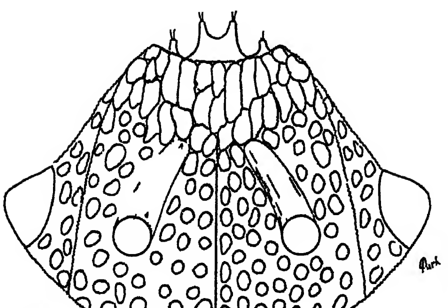
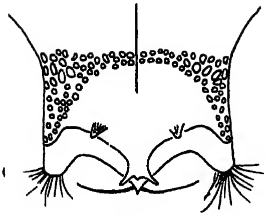


8

PLATE VII

1. *temporalis*, male, antennal segments X and XI, ventral face.
2. *temporalis*, male, frontal declivity, seen from above.
3. *scabriceps*, male, frontal declivity, seen from above.
4. *temporalis*, aedeagus, 0 294 mm. long x 0 119 mm. wide.
5. *nigricans*, male, mesial view of antennal segments I, II, III, drawn from type (MCZ 6171)
6. *lineaticollis*, male, dorsal view of head



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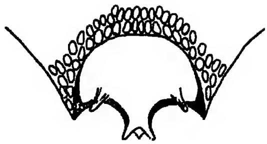

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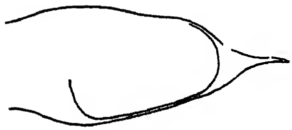

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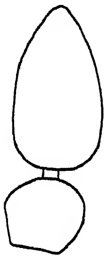

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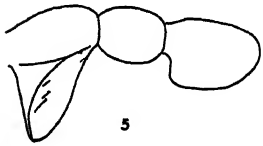
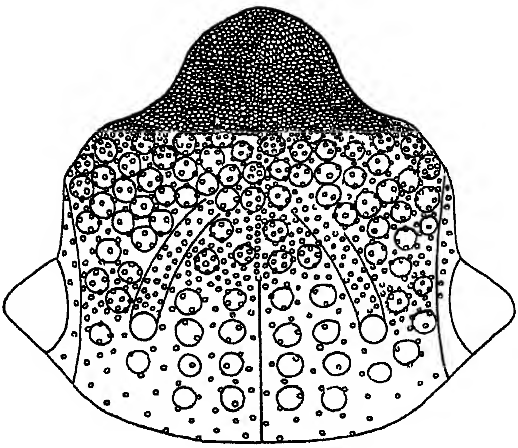


5



6

PLATE VIII

Batrisodes globosus (LeConte) feeding on an oribatid mite.

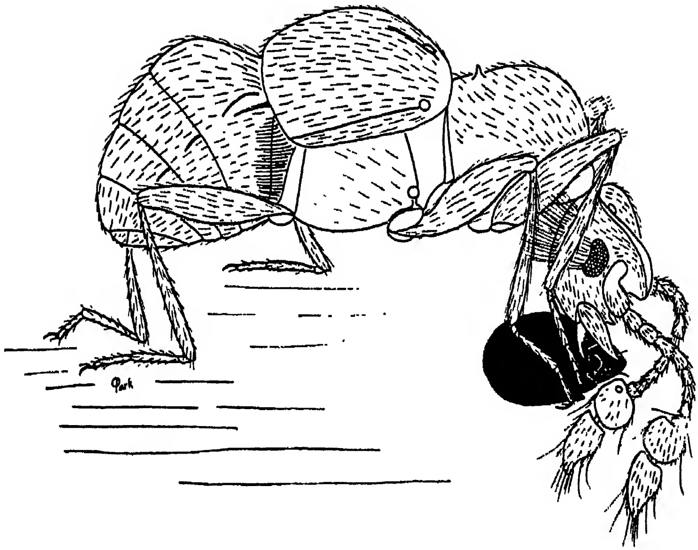

Park

PLATE IX

Distribution of *Batrisodes frontalis* (LeConte) and *Batrisodes globosus* (LeConte). Circles represent authentic locality records for *globosus* and triangles for *frontalis.* Arrows suggest possible former dispersal routes. See text for discussion.

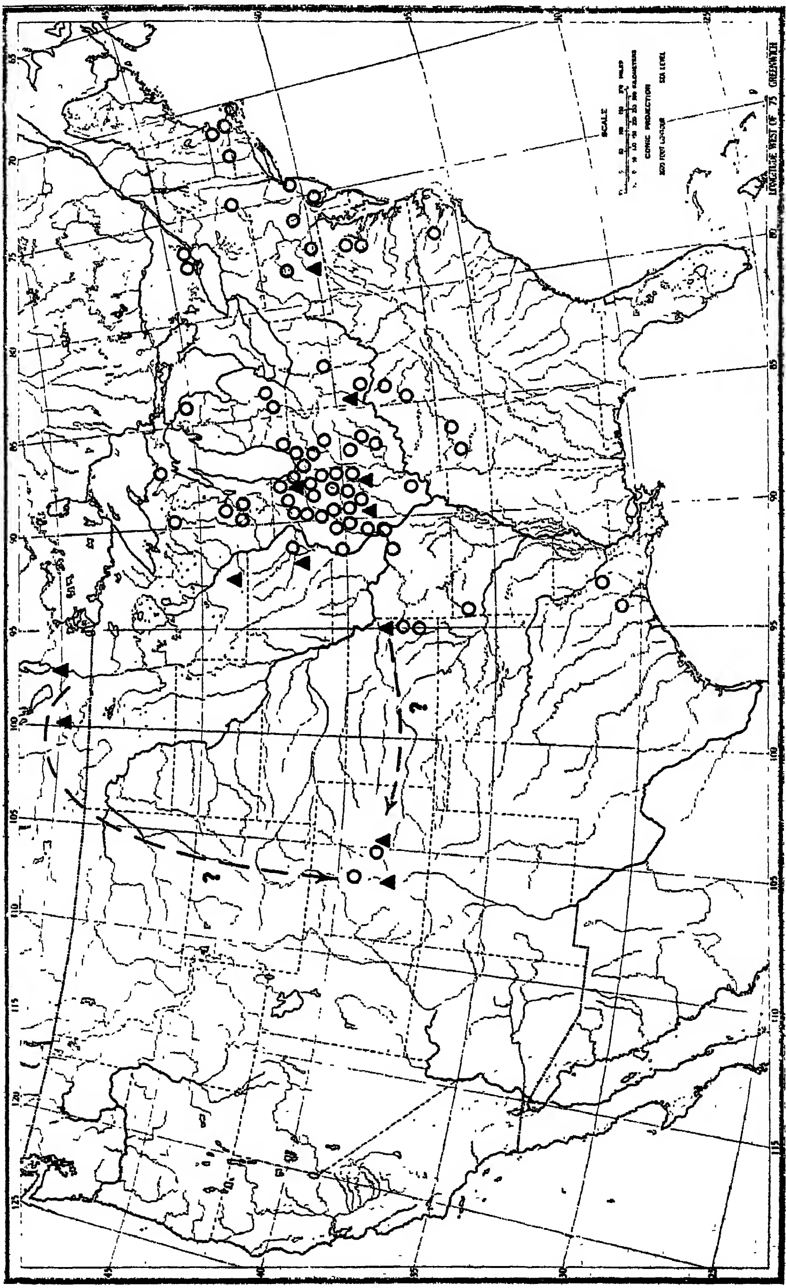

Prepared by J Paul Goode. Published by The University of Chicago Press, Chicago, Illinois. Copyright 1930 by The University of Chicago.

PLATE X

Distribution of the genus *Batrisodes*. Each black spot represents one species. Arrows suggest hypothetical and very generalized routes of possible dispersals.

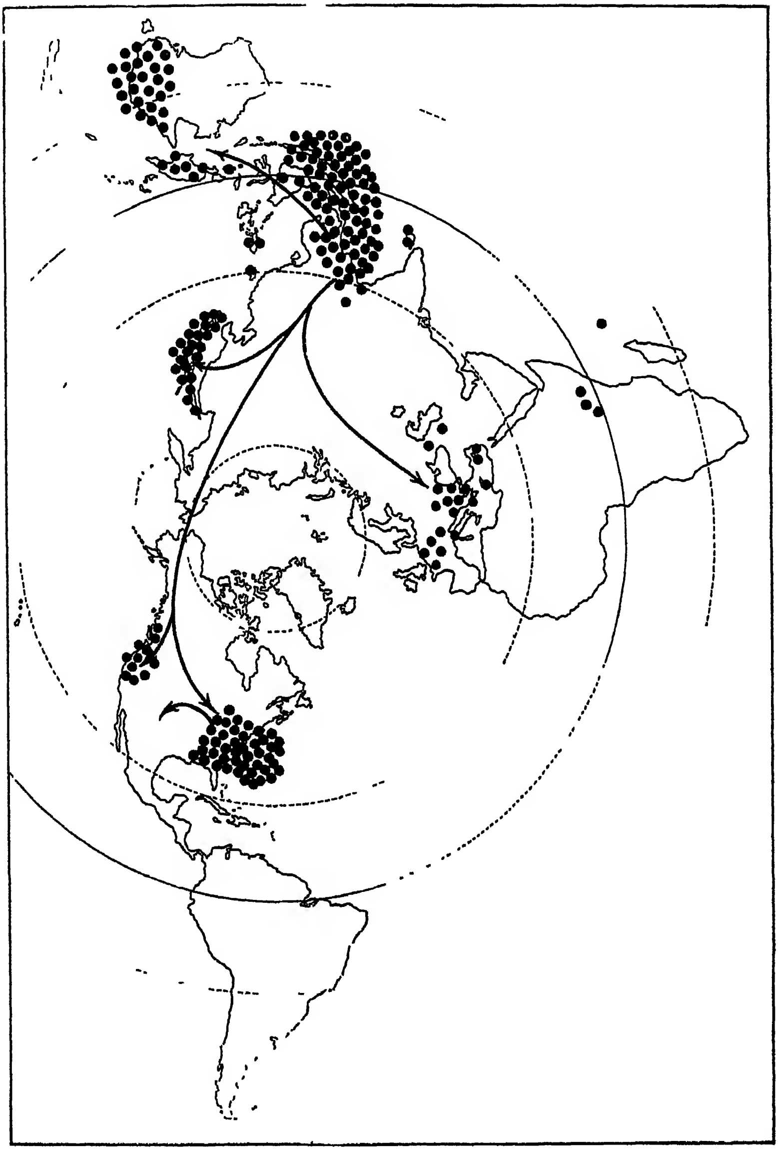
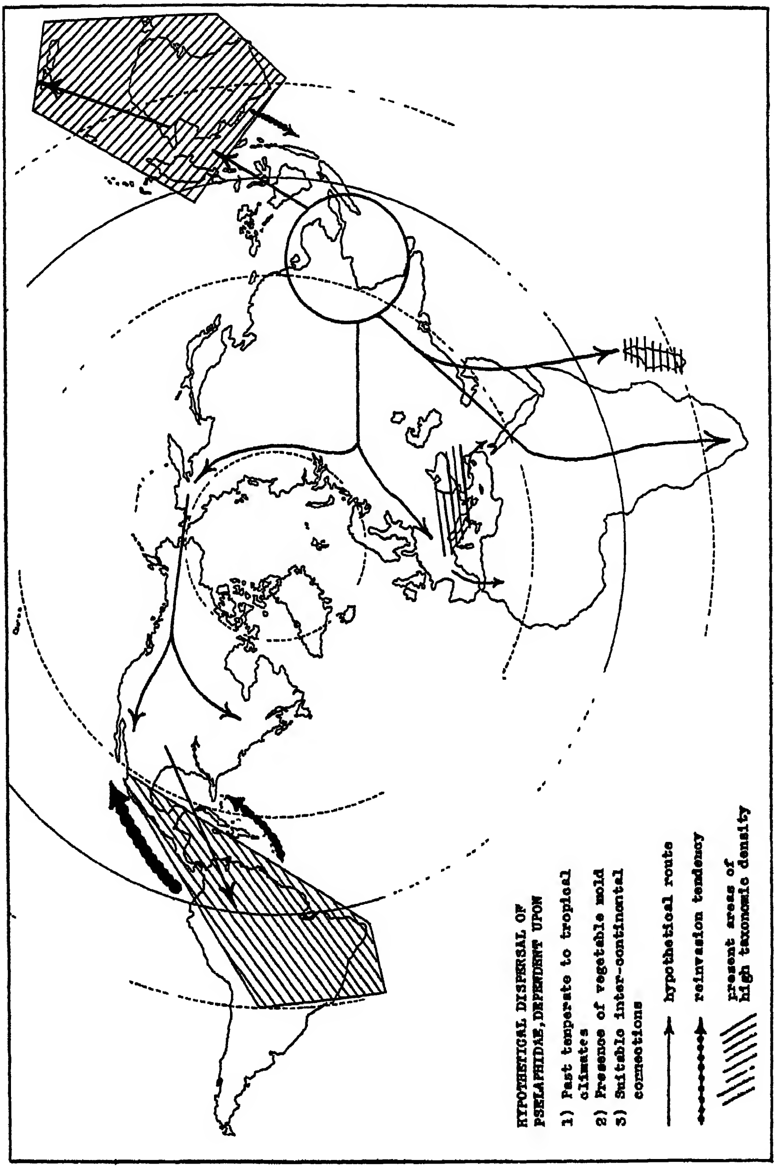


PLATE XI

Hypothetical dispersals of Pselaphidae.


HYPOTHETICAL DISPERSAL OF
PSELAPHIDAE, DEPENDENT UPON
1) Past temperate to tropical
climates
2) Presence of vegetable mold
3) Suitable inter-continental
connections
hypothetical route
reinvasion tendency
present areas of
high taxonomic density

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of the
Chicago Academy of Sciences

Checklist of the Genus *Batrisodes* (Coleoptera: Pselaphidae)

ORLANDO PARK
Northwestern University

Chicago
Published by the Academy
1948

The Bulletin of the Chicago Academy of Sciences was initiated in 1883 and volumes 1 to 4 were published prior to June, 1913. During the following twenty-year period it was not issued. Volumes 1, 2, and 4 contain technical or semi-technical papers on various subjects in the natural sciences. Volume 3 contains museum reports, descriptions of museum exhibits, and announcements.

Publication of the *Bulletin* was resumed in 1934 with volume 5 in the present format. It is now regarded as an outlet for short to moderate-sized original papers on natural history, in its broad sense, by members of the museum staff, members of the Academy, and for papers by other authors which are based in considerable part upon the collections of the Academy. It is edited by the Director of the Museum with the assistance of a committee from the Board of Scientific Governors. The separate numbers are issued at irregular intervals and distributed to libraries and scientific organizations, and to specialists with whom the Academy maintains exchanges. A reserve is set aside for future need as exchanges and the remainder of the edition offered for sale at a nominal price. When a sufficient number of pages have been printed to form a volume of convenient size, a title page, table of contents, and index are supplied to libraries and institutions which receive the entire series.

Howard K. Gloyd, Director of the Museum

Committee on Publications:

Alfred Emerson, Professor of Zoology, University of Chicago.
C. L. Turner, Professor of Zoölogy, Northwestern University.
Hanford Tiffany, Professor of Botany, Northwestern University.

Vol. 8, No. 4 April 15, 1948

Bulletin
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Checklist of the Genus *Batrisodes* (Coleoptera: Pselaphidae)

ORLANDO PARK
Northwestern University

Achille Raffray in 1911 listed the species of Pselaphidae then known. The following checklist of the genus *Batrisodes* integrates new material that has accumulated in the past thirty-six years. At present there are 214 species of *Batrisodes* known. These are distributed as follows: Palaearctic 41, Nearctic 52, Ethiopian 4, Neotropical 0, Oriental 83, and Australian 34.

The following list has been organized upon a faunal basis for future zoögeographic study. Local studies are noted with reference to particular areas but several papers of a more general nature include keys to groups and group composition (Raffray, 1904), checklists (Raffray, 1908, 1911), faunal lists (Raffray, 1923-1924), center of origin and dispersal routes (Park, 1947).

ORIENTAL REGION

BORNEO

incertus (Schaufuss)
Batrisus incertus Schaufuss, Ann. Mus. Civ. Genoa, vol. 18, p. 392, 1882.
Type locality: Borneo.

BURMA

carinatus Blattny
Sbornik ent. Odd. Narod. Mus. Prague, vol. 3, no. 26, p. 190, 1925.
Type locality: Burma.

kavinai **Blattny**

Ibid., p. 193.

Type locality: Burma.

plicatus **Blattny**

Ibid., p. 194.

Type locality: Burma.

vavrai **Blattny**

Ibid., p. 191.

Type locality: Burma.

CEYLON

armatus **(Raffray)**

Batrisus armatus Raffray, Ann. Soc. ent. France, vol. 62, p. 447, 1893.

Type locality: Nuwara-Eliya to Maturata, Ceylon.

spinicollis **(Motschulsky)**

Batrisus spinicollis Motschulsky, Etud. ent., p. 27, 1858.

Type locality: Ceylon. Additional records: Nuwara-Eliya, Ceylon (Raffray, 1893, p. 447).

shingalensis **Raffray**

Ann. Soc. ent. France, vol. 83, p. 27, 1914.

Type locality: Banderawella, Ceylon.

saucius **Raffray**

Ibid., p. 27, 1914.

Type locality: Trincomalee, Ceylon.

FEDERATED MALAY STATES

alacer **(Raffray)**

Batrisus alacer Raffray, Revue d' Entomologie, vol. 13, p. 245, 1894.

Type locality: Singapore.

auriculatus **(Raffray)**

Batrisus auriculatus Raffray, *ibid.*, vol. 13, p. 247, pl. I, fig. 9, 1894.

Type locality: Singapore. Additional records: Palembang, Sumatra (Raffray, 1904, p. 208).

bispina **(Raffray)**

Batrisus bispina Raffray, *ibid.*, vol. 13, p. 234, 1894.

Type locality: Singapore.

crenatulus **(Raffray)**
Batrisus crenatulus Raffray, *ibid.*, vol. 13, p. 259, 1894.
Type locality: Penang.

cribratus **(Raffray)**
Batrisus cribratus Raffray, *ibid.*, vol. 13, p. 260, 1894.
Type locality: Penang.

dux **(Raffray)**
Batrisus dux Raffray, *ibid.*, vol. 13, p. 254, 1894.
Type locality: Singapore.

edentatus **(Raffray)**
Oxarthrius edentatus Raffray, *ibid.*, p. 263, 1894.
Type locality: Singapore.

elegans **(Raffray)**
Batrisus elegans Raffray, *ibid.*, p. 244, pl. I, fig. 7, 1894.
Type locality: Singapore.

galeatus **(Raffray)**
Batrisus galeatus Raffray, *ibid.*, p. 252, pl. I, fig. 11, 1894.
Type locality: Singapore.

geminus **(Raffray)**
Batrisus geminus Raffray, *ibid.*, p. 249, 1894.
Type locality: Penang and Singapore.

hepaticus **(Raffray)**
Batrisus hepaticus Raffray, *ibid.*, p. 257, 1894.
Type locality: Singapore and Penang.

hirtellus **(Raffray)**
Batrisus hirtellus Raffray, *ibid.*, p. 256, 1894.
Type locality: Penang.

hispidulus **(Raffray)**
Batrisus hispidulus Raffray, *ibid.*, p. 258, 1894.
Type locality: Penang.

quadrispina **(Raffray)**
Batrisus quadrispina Raffray, *ibid.*, p. 243, 1894.
Type locality: Singapore.

quinquesulcatus (Raffray)

Batrisus quinquesulcatus Raffray, *ibid.*, p. 241, pl. I, fig. 6, 1894.

Type locality: Singapore. Ranges into Sumatra.

latipalpus (Raffray)

Batrisus latipalpus Raffray, *ibid.*, p. 237, 1894.

Type locality: Singapore.

merulus (Raffray)

Batrisus merulus Raffray, *ibid.*, p. 250, 1894.

Type locality: Penang.

miles (Raffray)

Batrisus miles Raffray, *ibid.*, p. 251, 1894.

Type locality: Singapore.

montivagus (Raffray)

Batrisus montivagus Raffray, *ibid.*, p. 248, 1894.

Type locality: Penang.

paradoxus (Raffray)

Batrisus paradoxus Raffray, *ibid.*, p. 244, 1894.

Type locality; Penang.

parens (Raffray)

Batrisus parens Raffray, *ibid.*, p. 236, 1894.

Type locality: Singapore.

penangensis (Raffray)

Oxarthrius penangensis Raffray, *ibid.*, p. 261, 1894.

Type locality: Penang.

persimilis (Raffray)

Batrisus persimilis Raffray, *ibid.*, p. 235, 1894.

Type locality: Penang.

platycephalus (Raffray)

Batrisus platycephalus Raffray, *ibid.*, p. 242, 1894.

Type locality: Singapore.

praeclarus (Raffray)

Batrisus praeclarus Raffray, *ibid.*, p. 253, 1894.

Type locality: Singapore and Penang. Ranges into Sumatra.

rajah **(Raffray)**

Batrisus rajah Raffray, *ibid.*, p. 246, 1894.

Type locality: Singapore.

satelles **(Raffray)**

Batrisus satelles Raffray, *ibid.*, p. 248, 1894.

Type locality: Singapore. Ranges into Palembang, Sumatra.

singapuriensis **(Raffray)**

Batrisus singapuriensis Raffray, *ibid.*, p. 241, 1894.

Type locality: Singapore.

sylvicola **(Raffray)**

Batrisus sylvicola Raffray, *ibid.*, p. 336, 1894.

Type locality: Singapore.

tropicus **(Raffray)**

Batrisus tropicus Raffray, *ibid.*, p. 260, 1894.

Type locality: Penang.

vagepunctatus **(Raffray)**

Batrisus vagepunctatus Raffray, *ibid.*, p. 254, 1894.

Type locality: Singapore.

verticicornis **(Raffray)**

Batrisus verticicornis Raffray, *ibid.*, p. 250, pl. I, fig. 10, 1894

Type locality: Penang.

vulneratus **(Raffray)**

Batrisus vulneratus Raffray, *ibid.*, p. 254, 1894.

Type locality: Penang.

FORMOSA

semipunctatus **Raffray**

Ent. Mitt., vol. 1, p. 104, 1912.

Type locality: Formosa.

INDIA

No species of *Batrisodes* are known from this large subcontinent but many probably occur. Fowler (1912, p. 82) writing of Indian pselaphids in general states "Very little is known of the Indian members of the group, although they are probably very numerous; several European genra are represented as . . . . *Batrisus.*"

INDO-CHINA

***faustus* (Raffray)**

Batrisus faustus Raffray, Ann. Soc. ent. France, vol. 65, p. 237, 1896.

Type locality: Birmanie.

JAVA

***achillei* (Schaufuss)**

Batrisus achillei Schaufuss, Ann. Mus. Civ. Genoa, vol. 18, p. 386, 1882.

Type locality: Java.

***angusticollis* (Raffray)**

Batrisus angusticollis Raffray, Revue d' Entomologie, vol. 1, p. 74, 1882.

Type locality: Java.

***beccarii* Raffray**

Ann. Soc. ent. France, vol. 73, p. 211, 1904. *nom. nov.*

Batrisus longipennis Schaufuss (*nec* Raffray), Ann. Mus. Civ. Genoa, vol. 18, p. 387, 1882.

Type locality: Java.

***bicolor* (Raffray)**

Batrisus bicolor Raffray, Revue d' Entomologie, vol. 1, p. 63, 1882.

Batrisus raffrayi Reitter, Verh. z. b. Ges. Wien, vol. 32, p. 285, 1882.

Type locality: Java.

***capitatus* (Raffray)**

Batrisus capitatus Raffray, Revue d' Entomologie, vol. 1, p. 73, 1882.

Type locality: Java.

***exiguus* (Raffray)**

Batrisus exiguus Raffray, *ibid.*, vol. 1, p. 61, 1882.

Batrisus nicotianus Schaufuss, Ann. Mus. Civ. Genoa, vol. 18, p. 393, 1882.

Batrisus lateridens Reitter, Verh. z. b. Ges. Wien, vol. 33, p. 398, 1883.

Type locality: Java. Ranges into Sumatra and Borneo.

***javanicus* (Raffray)**

Batrisus javanicus Raffray, Revue d' Entomologie, vol. 1, p. 63, 1882.

Type locality: Java. Ranges into Sumatra.

***longipennis* (Raffray)**

Batrisus longipennis Raffray, *ibid.*, vol. 1, p. 64, 1882.

Type locality: Java.

pubescens (Raffray)
Batrisus pubescens Raffray, *ibid.*, vol. 1, p. 62, 1882.
Type locality: Java.

semisulcatus (Schaufuss)
Batrisus semisulcatus Schaufuss, Ann. Mus. Civ. Genoa, vol. 18, p. 391, 1882.
Type locality: Java.

PHILIPPINES

cavicola (Raffray)
Batrisus cavicola Raffray, Ann. Soc. ent. France, vol. 60, p. 476, pl. 14, fig. 1, 1891.
Type locality: San Mateo, Manila, Luzon.

verticinus (Raffray)
Batrisus verticinus Raffray, *ibid.*, vol. 60, p. 477, 1891.
Type locality: San Mateo Grotto, Manila, Luzon.

SUMATRA (cf. revision of Sumatran pselaphids, by Raffray, 1892)

acinosus Raffray
Ann. Soc. ent. France, vol. 73, p. 147, fig. 19, 1904.
Type locality: Palembang, Sumatra.

asper (Raffray)
Batrisus asper Raffray, Ann. Soc. ent. France, vol. 65, p. 240, 1896.
Type locality: Palembang, Sumatra.

cavifrons (Raffray)
Batrisus cavifrons Raffray, Ann. Soc. ent. France, vol. 61, p. 478, 1892.
Type locality: Sumatra.

carbunculus (Raffray)
Batrisus carbunculus Raffray, *ibid.*, vol. 65, p. 239, 1896.
Type locality: Palembang, Sumatra.

clavicornis (Raffray)
Batrisus clavicornis Raffray, *ibid.*, vol. 61, p. 480, pl. 10, fig. 6, 1892.
Type locality: Sumatra

demissus Raffray
Ibid., vol. 73, p. 154, 1904.
Type locality: Palembang, Sumatra.

dispar (Raffray)
Batrisus dispar Raffray, *ibid.*, vol. 61, p. 478, 1892.
Type locality: Sumatra. Ranges into Singapore.

ferinus Raffray
Ibid., vol. 73, p. 148, fig. 20, 1904.
Type locality: Palembang, Sumatra.

griseopubescens (Raffray)
Batrisus griseopubescens Raffray, *ibid.*, vol. 65, p. 238, 1896.
Type locality: Palembang, Sumatra.

holosericeus (Schaufuss)
Batrisus holosericeus Schaufuss, Ann. Mus. Civ. Genoa. vol. 18, p. 387, 1882.
Type locality: Sumatra.

indecorus Raffray
Ann. Soc. ent. France, vol. 73, p. 152, 1904.
Type locality: Palembang, Sumatra.

infandus Raffray
Ibid., vol. 73, p. 150, 1904.
Type locality: Palembang, Sumatra.

irritus Raffray
Ibid., vol. 73, p. 153, fig. 25, 1904.
Type locality: Palembang, Sumatra.

luteolus Raffray
Ibid., vol. 73, p. 145, 1904.
Type locality: Palembang, Sumatra.

mavortius Raffray
Ibid., vol. 73, p. 152, fig. 22, 1904.
Type locality: Palembang, Sumatra.

multiforus Raffray
Ibid., vol. 73, p. 149, 1904.
Type locality: Palembang, Sumatra.

muticus (Raffray)
Batrisus muticus Raffray, *ibid.*, vol. 61, p. 479, 1892.
Type locality: Sumatra.

nodosus Raffray
Ibid., vol. 73, p. 151, fig. 21, 1904.
Type locality: Palembang, Sumatra.

obesus Raffray
Ibid., vol. 73, p. 144, 1904.
Type locality: Palembang, Sumatra.

patranus Raffray
Ibid., vol. 73, p. 151, 1904.
Type locality: Palembang, Sumatra.

ritsemae (Schaufuss)
Batrisus ritsemae Schaufuss, Tijdschr. voor Entom., vol. 25, p. 70, 1882.
Type locality: Sumatra.

rudis (Raffray)
Batrisus rudis Raffray, Ann. Soc. ent. France, vol. 65, p. 240, 1896.
Type locality: Sumatra.

sagax Raffray
Ibid., vol. 73, p. 154, 1904.
Type locality: Sumatra.

tenuicornis Raffray
Ibid., vol. 73, p. 149, 1904.
Type locality: Palembang. Sumatra.

transversalis (Raffray)
Batrisus transversalis Raffray, *ibid.*, vol. 65, p. 241, 1896.
Type locality: Sumatra.

tricarinatus Raffray
Ibid., vol. 73, p. 146, 1904.
Type locality: Palembang, Sumatra.

tuberculatus Raffray
Ibid., vol. 73, p. 146, 1904.
Type locality: Palembang, Sumatra.

ETHIOPIAN REGION

AFRICA

articularis Raffray

Voy. Alluaud et Jeannel Afrique Orientale, p. 31, 1913.

Type locality: Tavéta, Afrique orientale anglaise, 750 meters, at light.

gladiator Raffray

Ibid., p. 33, 1913.

Type locality: Shimoni, Afrique orientale anglaise.

heterocerus Raffray

Ibid., p. 32, 1913.

Type locality: Kenya, forêts inférieures; 2400 meters.

SEYCHELLES

caudatus Raffray

Trans. Linn. Soc. London, vol. 16, p. 130, pl. 10, figs. 8, 9, 1913.

Type locality: Seychelles Islands.

AUSTRALIAN REGION

AUSTRALIA (cf. general paper by Raffray, 1900).

apicicollis Lea

Proc. Linn. Soc. New South Wales, vol. 35, p. 712, 1911.

Type locality: Australia.

arthuri nom. nov.

For *Batrisodes punctifrons* Lea, Proc. Linn. Soc. New South Wales, vol. 35, p. 712-716, 1911. Preoccupied by *Batrisodes punctifrons* (Casey), 1887, Pennsylvania, U. S. A.

Type locality: Australia.

asperulus (Raffray)

Batrisus asperulus Raffray, Proc. Linn. Soc. New South Wales, vol. 24, p. 139, pl.10, fig. 26, 1900.

Type locality: Australia.

bifoveiceps Lea

Proc. Linn. Soc. New South Wales, vol. 36, p. 431, 1912.

Type locality: Brisbane, Queensland.

bimucronatus (Raffray)

Batrisus bimucronatus Raffray, Proc. Linn. Soc. New South Wales, vol. 24, p. 142, 1900.

Type locality: Clarence River Valley, New South Wales.

clavitarsis Oke

Proc. Linn. Soc. New South Wales, vol. 57, p. 152, 1932.

Type locality: New South Wales.

conspicuus (King) (?)

Batrisus (?) *conspicuus* King, Trans. Ent. Soc. New South Wales, 1865, p. 171.

Type locality: Parramatta, New South Wales.

cyclops (King)

Batrisus cyclops King, *ibid.*, 1866, p. 306; Raffray, Proc. Linn. Soc. New South Wales, vol. 24, p. 137, pl. 10, fig. 28, 1900.

Batrisus giraffa Schaufuss, Ann. Soc. ent. Belg., p. 31, 1880; Nunquam Otiosus, vol. III, p. 507, 1880 (Dresden). Synonymy *teste* Raffray, p. 138, 1900.

Batrisodes cyclops Raffray, Ann. Soc. ent. France, vol. 73, p. 84, 1904; Genera Insectorum, fas. 64, Pselaphidae, p. 159, 1908.

Type locality: Parramatta, New South Wales. Schaufuss gives the type locality of *giraffa* as Pine Mountain, Brigham, Australia. Raffray (1900) querried Brigham, and questioned whether Schaufuss meant Brisbane. Since this latter locality is in Queensland, it is unlikely. I find no Brigham listed for Australia, and suspect that the Brigham of Schaufuss is Bingham, New South Wales. Raffray (1904, 1908) cites *cyclops* from Pine Mountain, Parramatta, New South Wales.

gibbosus (King)

Batrisus gibbosus King, *ibid.*, 1866, p. 307.

Type locality: Australia.

gracilicornis Oke

Proc. Linn. Soc. New South Wales, vol. 57, p. 152, 1932. *nom. nov. Batrisodes tenuicornis* Lea, *ibid.*, vol. 35, p. 712, 1911.

Type locality: Australia.

elizabethae (King)

Batrisus elizabethae King, Trans. Ent. Soc. New South Wales, 1864, p. 104.

Type locality: Sydney, New South Wales.

falsus (Raffray)

Batrisus falsus Raffray, Proc. Linn. Soc. New South Wales, vol. 24, p. 144, 1900;

Type locality: Forest Reefs, New South Wales.

gibbicollis Lea

Proc. Linn. Soc. New South Wales, vol. 35, p. 712, 1911.

Type locality: Australia.

hamatus (King)

Batrisus hamatus King, Trans. Ent. Soc. New South Wales, 1863, p. 45, pl. 16, fig. 6c; Raffray, Proc. Linn. Soc. New South Wales, vol. 24, p. 140, 1900.

Type locality: Australia. Reported from Sydney and Parramatta, New South Wales by Raffray, 1900.

hirtus (MacLeay)

Bryaxis hirta MacLeay, Trans. Ent. Soc. New South Wales, 1873, p. 152; Raffray, Proc. Linn. Soc. New South Wales, vol. 24, p. 139, 1900, *(Batrisus)*; Raffray, Ann. Soc. ent. France, vol. 73, p. 205, 1904 *(Batrisodes)*.

Type locality: Australia. Reported from Gayndah, Queensland by Raffray, 1900.

insignicollis Lea

Proc. Linn. Soc. New South Wales, vol. 35, p. 712, 1911.

Type locality: Australia.

kershawi Lea

Ibid., vol. 35, p. 712-716, 1911.

Type locality: Australia.

laticollis Lea

Ibid., vol. 36, p. 431-435, 1912.

Type locality: New South Wales.

leai (Raffray)

Batrisus leai Raffray, Proc. Linn. Soc. New South Wales, vol. 24, p. 142, 1900, Ann. Soc. ent. France, vol. 73, p. 205, 1904 *(Batrisodes)*.

Type locality: Tamworth, New South Wales.

macrocephalus Lea

Proc. Linn. Soc. New South Wales, vol. 36, p. 431-435, 1912.

Type locality: Gayndah, Queensland.

myrmecophilus Lea

Proc. Royal Soc. Victoria, vol 23, p. 148, 1911.

Type locality: Victoria.

nobilis (King)

Batrisus nobilis King, Trans. Ent. Soc. New South Wales, 1865, p. 170.

Batrisodes nobilis Raffray, Ann. Soc. ent. France, vol. 73, p. 205, 1904; Genera Insectorum, fas. 64, p. 160, 1908.

Type locality: Parramatta, New South Wales.

rugicornis (Raffray)

Batrisus rugicornis Raffray, Proc. Linn. Soc. New South Wales, vol. 24, p. 143, 1900.

Batrisodes rugicornis Raffray, Ann. Soc. ent. France, vol. 73, p. 205, 1904.

Type locality: New South Wales.

sculpticollis Lea

Proc. Linn. Soc. New South Wales, vol. 36, p. 431-435, 1912.

Type locality: New South Wales.

speciosus (King)

Batrisus speciosus King, Trans. Ent. Soc. New South Wales, 1863, p. 45; Raffray, Proc. Linn. Soc. N. S. W., vol. 24, p. 141, 1900.

Batrisodes speciosus Raffray, Ann. Soc. ent. France, vol. 73, p. 205, 1904.

Type locality: Australia. Reported from Forest Reefs, New South Wales by Raffray, 1900.

ursinus (Schaufuss)

Batrisus ursinus Schaufuss, Ann. Soc. ent. Belg., p. 31, 1880; Raffray, Proc. Linn. Soc. N. S. W., vol. 24, p. 138, pl. 10, fig. 27, 1900.

Batrisodes ursinus Raffray, Ann. Soc. ent. France, vol. 73, p. 205, 1904.

Type locality: Wide Bay, Queensland.

MOLUCCAS

moluccarum (Raffray)

Batrisus moluccarum Raffray, Revue d' Entomologie, vol. 1, p. 61, 1882.

Type locality: Moluccas.

NEW GUINEA (PAPUA)

hatamensis (Schaufuss)

Batrisus hatamensis Schaufuss, Ann. Mus. Civ. Genoa, vol. 18, p. 392, 1882.

Type locality: Hatam Mountains, New Guinea.

horvathi Raffray

Ann. Mus. Nat. Hung. (Budapest), 1903, p. 46, pl. 2, fig. 4.

Type locality: Sattelberg and Madang (Friedrich-Wilhemshafen).

papuanus (Raffray)

Batrisus papuanus Raffray, Revue d' Entomologie, vol. 1, p. 41, 1882; Ann. Mus. Nat. Hung., 1903, p. 45; Ann. Soc. ent. France, vol. 73, p. 206, 1904; Genera Insectorum, fas. 64, p. 160, 1908.

Type locality: New Guinea.

punctatissimus (Raffray)

Batrisus punctatissimus Raffray, Revue d' Entomologie, vol. 1, p. 60, 1882.

Type locality: New Guinea.

simplex **(Raffray)**

Batrisus simplex Raffray, Revue d' Entomologie, vol 1, p 58, 1882, Ann. Soc ent. France, vol. 73, p. 207, 1904; Genera Insectorum, fas 64, p. 160

Batrisus anthicathedrus Schaufuss, Bull. Soc. ent. France, p. cxvi, 1883.

Batrisus raffrayi Casey, Contr. Des. and Sys. Col. N. Am., part I, p. 92, 1884. *Nom. nov.* because of *simplex* (LeConte), 1878 of Michigan, but LeConte's species a synonym of *striatus* (LeConte), 1850, *teste* Casey, 1893, p. 472, and original name proposed by Raffray valid.

Type locality: New Guinea.

testaceus **(Raffray)**

Batrisus testaceus Raffray, Revue d' Entomologie, vol. 1, p. 59, 1882.

Type locality: New Guinea.

TASMANIA

australis **(Erichson)**

Batrisus (?) *australis* Erichson, Wigm. Arch., vol. 1, p. 243, 1842; *Batrisodes* (?), Raffray, Ann. Soc. ent. France, vol. 73, p. 205, 1904; *Batrisodes*, Raffray, Genera Insectorum, fas. 64, p. 160, 1908.

Type locality: Tasmania

PALAEARCTIC REGION

EUROPE (cf. papers by Reichenbach, 1816; Denny, 1825; Aubé, 1833, 1844; Ganglbauer, 1895; Reitter, 1909; Raffray, 1914).

adnexus **(Hampe)**

Hampe, Wien. Ent. Monats., 1863, p. 285.

Batrisodes adnexus Raffray, Ann. Soc. ent. France, vol 73, p. 201, 1904; Genera Insectorum, fas. 64, p. 158, 1908; Ann. Soc. ent. France, vol. 83, p. 379, 1914. Reitter, Fauna Germanica, Kafer, vol. 2, p. 211 (*con Lasius brunneus*), 1909. Donisthorpe, Ent. Rec., vol. 36, p. 117 (*con* ants), 1924.

Range: Great Britain, Germany, southern France, Austria, central Italy, Greece.

adnexus humeralis **Ruschkamp**

Ent. Bl., vol. 28, p. 157, 1932.

Range: Germany.

delaporti (Aubé)

Batrisus delaporti Aubé, Monographia Pselaphiorum, 1833, p. 46, pl. 89, fig 2; LeConte, Boston Jour. Nat. Hist., vol 6, p. 93, 1850.

Batrisodes delaportei Reitter, 1909, p 211; Donisthorpe, Ent. Rec., vol 36, p. 117 (*con* ants), 1924.

Batrisodes laportei Raffray, 1904, p. 201, 1908, p. 158; Bowman, Pselaphidae of North America, 1934, p. 144 (GENOTYPE by designation).

Batrisus puncticollis Tournier, Ann. Soc. ent. France, vol 36, p. 561, 1867, (*teste* Raffray, 1904, p. 201; Reitter, 1909, p. 211).

Batrisus schwabi Reitter, Berl. Ent. Zeits., 1870, p. 213 (*teste* Raffray, 1904, p. 201; Reitter, 1909, p. 211).

Type locality: *Gallia, "In ligno putrido semel Parisiis silva Bononiae in societate cum formicis minimis fulvis legi."*

Range: Great Britain, France, Germany, Switzerland, Austria, Greece.

elysius **Reitter**

Deuts. Ent. Zeits., vol. 28, p. 47, 1884; Raffray, 1904, p 202, 1908, p. 158.

Range: Greece.

exsculptus **(Hampe)**

Batrisus exsculptus Hampe, Stett. Ent. Zeit., 1850, p. 357.

Batrisodes exsculptus Raffray, 1904, p. 202; 1908, p. 158; Reitter, 1909, p. 211.

Type locality: Cyprus.

Range: Eastern Mediterranean area into Austria.

insularis **(Baudi)**

Batrisus insularis Baudi, Berl. Ent. Zeits., 1869, p. 407

Batrisodes insularis Raffray, 1904, p. 202; 1908, p. 158

Type locality: Cyprus.

moreanus **Reitter**

Wien. Ent. Zeit., 1893, p. 174; Raffray, 1904, p. 201; 1908, p. 158.

Range: Greece.

oculatus **(Aubé)**

Batrisus oculatus Aubé, 1833, p. 48, pl. 89, fig. 4; LeConte, 1850, p. 93.

Batrisodes oculatus Raffray, 1904, p. 202; 1908, p. 158; Reitter, 1909, p. 211; Raffray, 1914, p. 379.

Range: Europe.

paganettii **Blattny**

N. Beit. system. Insektenk., vol. 1, p. 2, 1916.

Type locality: Crete.

pogonatus (Saulcy)

Spec I, p 98

Batrisodes pogonatus Raffray, 1904, p 201; 1908, p 158

Range: Greece.

quadriceps Baudi

Nat. Sic., 1889, p 166

Batrisodes quadriceps Raffray, 1904, p. 201; 1908, p. 158

Range: Southern Italy.

roubali Machulka

Sbornik ent. Oddel. narod. Mus Praze, vol. 5, p 104, figs., 1927 (Prague).

Range: Czechoslovakia.

slovenicus Machulka

Ibid., vol. 3, p. 165, 1925.

Range: Slovakia.

venustus (Reichenbach)

Pselaphus venustus Reichenbach, Monographia Pselaphorum, 1816, p. 65, pl. 2, fig. 18.

Bryaxis nigriventris Denny, Monographia Pselaphidarum, 1825, p. 41, pl. 7, fig. 1 (*teste* Aubé, 1833, p. 48).

Batrisus brullei Aubé, 1833, p. 47, pl. 89, fig 3 (*teste* Raffray, 1904, p. 201; Reitter, 1909, p. 211).

Batrisus buqueti (Aubé), 1833, p. 50, pl. 90, fig. 4 (*teste* Raffray, 1904, p. 201, Reitter, 1909, p. 211).

Batrisus (?) *piceus* Mulsant & Rey, Opusc., vol. 12, p. 69 (*teste* Raffray, 1904, p. 201).

Batrisodes hubenthali Reitter, Ent. Mitt., vol. 2, p. 133, 1913 (Dalmatia) equals *B. buqueti* (Aubé) *teste* Machulka, Acta Soc. ent. Cech., vol. 26. p. 119, 1930.

Batrisus venustus Aubé, 1833, p. 48, pl. 90, fig. 1; LeConte, 1850, p. 93.

Batrisodes venustus Raffray, 1904, p. 201; 1908, p. 158; Reitter, 1909, p. 211. Rosenberg, Ent. Medd., vol. 14, p. 374 ff., 1924 (LARVA).

Range: Temperate Europe.

CAUCASUS

circassicus Reitter

Deuts. Ent. Zeits., vol. 31, p. 266, 1887; Raffray, Ann. Soc. ent. France, vol. 73, p. 202, 1904, Gen. Ins., fas. 64, p. 158, 1908.

Range: Western Caucasus.

ruprechti Kolenati

Melet. Ent., vol. 3, p. 31, pl. 12, fig. 3; Raffray, 1904, p. 201; 1908, p. 158.

Range: Transcaucasia; Lenkoran, Azerbaijan, S. S. R.

TIBET

pruinosus Reitter

Hor. Soc. Ent. Ross., vol. 23, p. 558; Raffray, 1904, p. 202; 1908, p. 158.

Range: Tibet (Amdo).

JAPAN (cf. papers by Sharp, 1874, 1883)

***acuminatus* (Sharp)**

Batrisus acuminatus Sharp, Trans. Ent. Soc. London, vol. 31, 1883, p. 307; Raffray, 1908, p. 161, 1874.

Type locality: Hakone, in decaying wood; Chiuzenji.

***angustus* (Sharp)**

Batrisus angustus Sharp, *ibid.*, vol. 22, 1874, p. 113; Raffray, 1908, p. 161.

Type locality: Japan.

***basicornis* (Sharp)**

Batrisus basicornis Sharp, *ibid.*, vol. 31, 1883, p. 312; Raffray, 1908, p. 161.

Type locality: Miyanoshita.

***caviceps* (Sharp)**

Batrisus caviceps Sharp, *ibid.*, vol. 31, 1883, p. 308; Raffray, 1908, p. 161.

Type locality: Yuyama.

***concolor* (Sharp)**

Batrisus concolor Sharp, *ibid.*, vol. 31, 1883, p. 310; Raffray, 1908, p. 161.

Type locality: Yokohama, with black ants.

***dionysius* (Schaufuss)**

Batrisus dionysius Schaufuss, Cat. Psel., p. 12.

(*spinicollis* Sharp, Trans. Ent. Soc. London, vol. 31, 1883, p. 304, *teste* Raffray, 1904, p. 210; Raffray, 1908, p. 161.)

Range: Hitoyoshi.

***epistomalis* Raffray**

Ann. Soc. ent. France, vol. 73, p. 136, fig. 24, 1904.

Type locality: Central Japan.

***fissifrons* (Sharp)**

Batrisus fissifrons Sharp, Trans. Ent. Soc. London, vol. 31, 1883, p. 311; Raffray, 1908, p. 161.

Type locality: Higo.

gracilis (Sharp)

Batrisus gracilis Sharp, *ibid.*, vol. 31, 1883, p. 315; Raffray, 1908, p. 161.

Type locality: Miyanoshita.

harmandi Raffray

Ann. Soc. ent. France, vol. 73, p. 155, fig. 23, 1904.

Type locality: Central Japan.

longicornis (Sharp)

Batrisus longicornis Sharp, Trans. Ent. Soc. London, vol. 31, 1883, p. 304; Raffray, 1908, p. 161.

Type locality: Miyanoshita; Ichiuchi, on the Kumagawa.

nipponensis Raffray

Ann. Soc. ent. France, vol. 78, p. 23, 1909.

Type locality: Kioto.

ornatifrons (Sharp)

Batrisus ornatifrons Sharp, Trans. Ent. Soc. London, vol. 31, 1883, p. 313; Raffray, 1908, p. 161.

Type locality: Chiuzenji.

ornatus (Sharp)

Batrisus ornatus Sharp, *ibid.*, vol. 22, 1874, p. 114; vol. 31, 1883, p. 312; Raffray, 1908, p. 161.

Type locality: Fukuhora; Nagasaki.

Range: Fukuhora; Nagasaki; Nikko; Yanoshiku; Bukenji, near Yokohama.

oscillator (Sharp)

Batrisus oscillator Sharp, *ibid.*, vol. 31, 1883, p. 309; Raffray, 1908, p. 161.

Type locality: With a species of *Formica* under a stone on the Mikuni togé.

palpalis (Sharp)

Batrisus palpalis Sharp, *ibid.*, vol. 31, 1883, p. 306; Raffray, 1908, p. 161.

Type locality: Mayebashi.

politus (Sharp)

Batrisus politus Sharp, *ibid.*, vol. 31, 1883, p. 310; Raffray, 1908, p. 161.

Type locality: With ants at Chiuzenji; log mold at Nishimura.

punctipennis (Sharp)

Batrisus punctipennis Sharp *ibid.*, vol. 31, 1883, p. 305; Raffray, 1908, p. 161.

Type locality: Miyanoshita and Hakone.

rugicollis (Sharp)

Batrisus rugicollis Sharp, *ibid.*, vol. 31, 1883, p. 313; Raffray, 1908, p. 161.

Type locality: Oyama, in Sagami; Miyanoshita.

solitarius (Sharp)

Batrisus solitarius Sharp, *ibid.*, vol. 31, 1883, p. 314; Raffray, 1908, p. 161.

Type locality: Kiga.

stipes (Sharp)

Batrisus stipes Sharp, *ibid.*, vol. 22, 1874, p. 115; Raffray, 1908, p. 161.

Type locality: Japan.

vestitus (Sharp)

Batrisus vestitus Sharp, *ibid.*, vol. 31, 1883, p. 307; Raffray, 1908, p. 161.

Type locality: Log mold at Hakone; Chiuzenji.

vulgaris Raffray

Ann. Soc. ent. France, vol. 78, p. 24, 1909.

Type locality: Kioto.

NEARCTIC REGION

See general papers by LeConte (1850), Brendel and Wickham (1890), Bowman (1934) and Park (1947).

albionicus (Aubé)

Batrisus albionicus Aubé, Monographia Pselaphiorum, 1833, p. 49, pl. 90, fig. 2; LeConte, 1850, p. 102; Brendel, 1866, p. 36; Henshaw, 1885, p. 29; Brendel and Wickham, 1890, p. 16; Casey, 1893, p. 470, 506.

Batrisodes albionicus Raffray, 1904, p. 82; 1908, p. 159; 1911; Leng, 1920, p. 129; Bowman, 1934, p. 61; Park, 1947, p. 107.

Batrisus aculeatus LeConte, Smiths. Misc. Coll. VI, no. 167, 1866, p. 21.

Type locality: British Columbia.

Range: British Columbia and California.

antennatus Shaeffer

Trans. Am. Ent. Soc., vol. 32, 1906 p. 262; Leng, 1920, p. 129; Bowman, 1934, p. 68; Brimley, 1938, p. 148; Park 1947, p. 80.

Type locality: Black Mountain, Buncombe County, North Carolina.

Known range: Buncombe and Yancey Counties, North Carolina.

aphaenogastri Fall

Psyche, vol. 19, 1912, p. 11; Leng, 1920, p. 129; Bowman, 1934, p. 61; Park, 1947, p. 110.

Type locality: Kendrick, Latah County, Idaho.

appalachianus Casey

Canadian Ent., vol. 40, 1908, p. 262; Leng, 1920, p. 129; Bowman, 1934, p. 72; Park, 1947, p. 87.

Type locality: Westmoreland County, Pennsylvania.

armiger (LeConte)

Batrisus armiger LeConte, Boston Jour. Nat. Hist., vol. 6, 1850, p. 94; Brendel, 1866, p. 36; Henshaw, 1885, p, 29; Brendel and Wickham, 1890, p. 10; Casey, 1893, p. 506.

Batrisodes armiger Raffray, 1904, p. 202; 1908, p. 159; 1911; Leng, 1920, p. 129; Bowman, 1934, p. 58; Brimley, 1942, p. 11; Park, 1947, p. 68.

Type locality: Pennsylvania.

Range: Allegheny Mountains, Pennsylvania south into Florida.

beyeri Schaeffer

Trans Am. Ent. Soc., vol. 32, 1906, p. 261; Leng, 1920, p. 129; Bowman, 1934, p. 66; Brimley, 1938, p. 148; Park, 1947, p. 81.

Type locality: Black Mountain, Buncombe County, North Carolina.

Known range: Buncombe and Yancey Counties, North Carolina.

bistriatus (LeConte)

Batrisus bistriatus LeConte, Boston Jour. Nat. Hist., vol. 6, 1850, p. 101; Brendel, 1866, p. 37; Henshaw, 1885, p. 29; Brendel and Wickham, 1890, p. 22; Casey, 1893, p. 506.

Batrisodes bistriatus Raffray, 1904, p. 204; 1908, p. 159; 1911; Leng, 1920, p. 129; Bowman, 1934, p. 67; Park, 1947, p. 78.

Type locality: Pennsylvania.

Range: Pennsylvania northward into Litchfield County, Connecticut.

carolinae (Casey)

Batrisus carolinae Casey, Ann. New York Acad. Sci., vol. 7, 1893, p. 468, 506.

Batrisodes carolinae Raffray, 1904, p. 202; 1908, p. 159; 1911; Leng, 1920, p. 129; Bowman, 1934, p. 59; Brimley, 1938, p. 148; Park, 1947, p. 71.

Type locality: Asheville, Buncombe County, North Carolina.

cartwrighti Sanderson

Ent. News, vol. 51, 1940, p. 169; Park, 1947, p. 78.

Type locality: Clemson, Oconee County, South Carolina.

caseyi Blatchley

Coleop. Indiana, 1910, p. 326.

Batrisodes caseyi Dury, in Leng, 1920, p. 130; Bowman, 1934, p. 76.

Batrisodes caseyi Blatchley, in Leng and Mutchler, 1933, p. 20; Park, 1947, p. 96.

(Unknown to author. Is this a possible synonym of *ionae* (LeConte) ?).

Range: Posey County, Indiana; Hamilton County, Ohio; Kenton County, Kentucky.

cavicornis Casey

Ann. New York Acad. Sci., vol. 9, 1897, p. 579; Raffray, 1904, p. 204; 1908, p. 159; 1911; Leng, 1920, p. 129; Bowman, 1934, p. 71; Park, 1947, p. 85.

Type locality: Westmoreland County, Pennsylvania.

Range: Westmoreland County, Pennsylvania south to Edmonson County, Kentucky and west through Hamilton County, Ohio to Pope County, Illinois.

cavicrus (Casey)

Batrisus cavicrus Casey, Ann. New York Acad. Sci., vol. 7, 1893, p. 468, 506.

Batrisodes cavicrus Raffray, 1904, p. 202; 1908, p. 159; 1911; Blatchley, 1910; Leng 1920, p. 129; Bowman, 1934, p. 58; Brimley, 1938, p. 148; Park, 1947, p. 68.

Type locality: Asheville, Buncombe County, North Carolina.

Range: Buncombe County, North Carolina south to Sassafras Mountains, South Carolina; west to Hamilton County, Ohio and Crawford County, Indiana.

cicatricosus (Brendel)

Batrisus cicatricosus Brendel and Wickham, Bull. Lab. Nat. Hist., St. Univ. Iowa, vol. 2, 1890, p. 15; Casey, 1893, p. 506.

Batrisodes cicatricosus Raffray, 1904, p. 203; 1908, p. 159, 1911; Leng, 1920, p. 129; Bowman, 1934, p. 63.

Type locality: Placer County, California.

clypeonotus (Brendel)

Batrisus clypeonotus Brendel, Trans. Am. Ent. Soc., vol. 20, 1893, p. 280, pl. 4, fig. 4; Casey, 1893, p. 506.

Batrisodes clypeonotus Raffray, 1904, p. 204; 1908, p. 159; 1911; Leng, 1920, p. 129; Bowman, 1934, p. 73; Park, 1947, p. 89.

Type locality: Ponchatoula, Tangipahoa Parish, Louisiana.

confinis (LeConte)

Batrisus confinis LeConte, Boston Soc. Nat. Hist., vol. 6, 1850, p. 96 (Type a male, not female as stated); Brendel, 1866, p. 36; Henshaw, 1885, p. 29; Brendel and Wickham, 1890, p. 12; Casey, 1893, p. 506; Dury, 1903, 1908.

Batrisodes confinis Raffray, 1904, p. 81; 1908, p. 159; 1911; Blatchley, 1910, p. 324; Leng, 1920, p. 129; Bowman, 1934, p. 59; Brimley, 1942, p. 11; Park, 1947, p. 69.

Batrisodes curvatus Sanderson, 1940, p. 170; *teste* Park, 1947, p. 70.

Type locality: Athens, Clarke County, Georgia.

Range: Oconee County, South Carolina, west through Georgia; north to Wake County, North Carolina, Hamilton County, Ohio and Putnam County, Indiana.

declivis Casey

Canadian Ent., vol. 40, 1908, p. 262; Leng, 1920, p. 129; Bowman, 1934, p. 68; Park, 1947, p. 80.

Type locality: Iowa City, Johnson County, Iowa.

denticauda (Casey)

Batrisus denticauda Casey, Ann. New York Acad Sci., vol 7, 1893, p 471, 506
Batrisodes denticauda Raffray. 1904, p. 203; 1908, p. 159, 1911; Leng, 1920, p. 129, Bowman, 1934, p. 63.

Type locality: Siskiyou County, California.

denticollis (Casey)

Batrisus denticollis Casey, Contr. Coleop. No. Amer., Philadelphia, 1884, p. 89; Brendel and Wickham, 1890, p. 27.
Batrisodes denticollis Raffray, 1904, p. 204; 1908, p. 159; 1911; Leng, 1920, p. 129; Leonard, 1928; Bowman, 1934, p. 74; Brimley, 1938; Park, 1942, p. 17; 1947, p. 93.

Type locality: Washington, District of Columbia.

Range: Round Knob, North Carolina north to New York; west to Iowa and Missouri.

fossicauda Casey

Ann. New York Acad Sci., vol. 9, 1897, p. 574; Wickham, 1900; Raffray, 1908, p. 159; Casey, 1908, p. 262; Leng, 1920, p. 129; Bowman, 1934, p. 67; Park, 1947, p. 79.

Type locality: Westmoreland County, Pennsylvania.

foveicornis (Casey)

Batrisus foveicornis Casey, Calif. Acad. Sci., Bull. 8, 1887, p. 462; Brendel and Wickham, 1890, p. 27; Casey, 1893, p. 506; Wickham, 1896.
Batrisodes foveicornis Raffray, 1904, p. 204; 1908, p. 159; 1911; Blatchley, 1910, p. 327; Leng, 1920, p. 129; Leonard, 1928; Bowman, 1934, p. 71; Park, 1947, p. 85.

Type locality: Tennessee.

Range: New York west to Johnson County, Iowa; south to Tennessee and Robertson County, Kentucky.

frontalis (LeConte)

Batrisus frontalis LeConte, Boston Soc. Nat Hist., vol. 6, 1850, p. 96; Brendel, 1866, p. 36; Henshaw, 1885, p. 29; Brendel and Wickham, 1890, p. 22; Casey, 1893, p. 506, Wickham, 1898, 1900; Dury, 1903, 1908.
Batrisodes frontalis Raffray, 1904, p. 203; 1908, p. 159; 1911; Casey, 1908; Leng, 1920, p. 129; Bowman, 1934, p. 66; Park, 1935, p. 213; 1947, p. 75.

Type locality: Pennsylvania.

Range: Olmsted County, Minnesota southward through Johnson County, Iowa, Missouri, and Douglas County, Kansas; eastward through Wisconsin and Manitoba on the north, and Hamilton County, Ohio on the south, to Pennsylvania. Apparently discontinuous, isolated population in El Paso and Chaffee Counties, Colorado. See discussion in Park, 1947, p. 117.

furcatus (Brendel)

Batrisus furcatus Brendel and Wickham, Bull. Lab Nat. Hist, St. Univ Iowa, vol. 2, 1890, p 8?, Casey, 1893, p 506.

Batrisodes furcatus Raffray, 1904, p. 204, 1908, p 159, 1911; Leng, 1920, p. 129; Bowman, 1934, p. 73; Park, 1942, p. 17, pl. 1, fig. 11; 1947, p. 88

Type locality: Southern Pennsylvania.

Range: Plymouth County, Massachusetts westward to Berrien County, Michigan; southward to Wake County, North Carolina, Lake County, Tennessee and southern Illinois.

globosus (LeConte)

Batrisus globosus LeConte, Boston Jour. Nat. Hist, vol 6, 1850, p. 100; Brendel, 1866, p. 36; Henshaw, 1885, p 29; Brendel, and Wickham, 1890, p. 23; Casey, 1893, p. 506; Wickham, 1898, 1900; Dury, 1903, 1908.

Batrisodes globosus Raffray, 1904, p. 204; 1908, p. 159; 1911; Blatchley, 1910, p. 326; Leng, 1920, p. 129; Leonard, 1928; Holmquist, 1928; Bowman, 1934, p. 69; Park, 1929, 1932, 1935a, b; 1942, p 1, 5, 17, pl 1, fig. 13, 14; 1947, p. 82.

Type locality: Pennsylvania.

Range: On the north from Quebec, Vermont, and Massachusetts, west into Vilas County, Wisconsin; southward through Johnson County, Iowa, Douglas and Montgomery Counties, Kansas, Washington County, Arkansas to Texas and Natchitoches Parish, Louisiana; eastward to central Florida. Apparently discontinuous, isolated population in Boulder and El Paso Counties, Colorado. See discussion in Park, 1947, p. 117.

hairstoni Park

Bull. Chicago Acad. Sci., vol. 8, 1947, p. 101.

Type locality: Clark County State Park, near Uno, Indiana, about thirteen miles north of Ohio River.

ionae (LeConte)

Batrisus ionae LeConte, Boston Jour. Nat. Hist Soc., vol. 6, 1850, p. 94; Brendel, 1866, p. 35; Henshaw, 1885, p. 29; Brendel, and Wickham, 1890, p. 9; Casey, 1893, p. 506.

Batrisodes ionae Raffray, 1904, p. 202; 1908, p. 158; 1911; Blatchley, 1910, p. 323; Leng, 1920, p. 129; Bowman, 1934, p. 58; Park, 1947, p. 65.

Type locality: Georgia.

Range: Bergen, Ocean, and Union Counties, New Jersey, through Cumberland County, Pennsylvania, southward through District of Columbia and Powell County, Kentucky into Georgia.

kahli Bowman

Pselaphidae N. Amer., 1934, p. 141; Blackwelder, 1939, p. 29; Park, 1947, p. 96.

Type locality: Tennessee.

lineaticollis (Aubé)

Batrisus lineaticollis Aubé, Monographia Pselaphiorum, 1833, p. 50, pl. 90, fig. 3. LeConte, 1850, p. 101; Brendel, 1866, p. 37; Henshaw, 1885, p. 29; Brendel and Wickham, 1890, p. 20; Casey, 1893, p. 506; Wickham, 1894.

Batrisodes lineaticollis Raffray, 1904, p. 203; 1908, p. 159; 1911; Blatchley, 1910, p. 326; Leonard, 1928; Bowman, 1934, p. 67; Park, 1947, p. 77.

Batrisodes lineatocollis Leng, 1920, p. 129.

Type locality: North America.

Range: New York and New Jersey. See discussion in Park, 1947, p. 77.

luculentus (Casey)

Batrisus luculentus Casey, Bull. California Acad. Sci., vol. 2, 1887, p. 460; Casey, 1893, p. 472, 506; Leng, 1920, p. 129; Bowman, 1934, p. 73; Park, 1947, p. 90.

Type locality: District of Columbia.

lustrans Casey

Canadian Entom., vol. 40, 1908, p. 260; Leng, 1920, p. 129; Bowman, 1934, p. 61; Park, 1947, p. 108.

Type locality: Lake Tahoe, California.

Range: California to Washington.

mendocino (Casey)

Bull. California Acad. Sci., vol. 1, 1886, p. 174; Casey, 1893, p. 470, 506.

Batrisodes mendocino Leng, 1920, p. 129; Bowman, 1934, p. 61; Park, 1947, p. 108.

Type locality: Anderson Valley, Mendocino County, California.

monstrosus (LeConte)

Batrisus monstrosus LeConte, Boston Jour. Nat. Hist., vol. 6, 1850, p. 95; Brendel, 1866, p. 36; Brendel and Wickham, 1890, p. 12; Casey, 1893, p. 506; Schwartz, 1895, Dury, 1903, 1908

Batrisodes monstrosus Raffray, 1904, p. 202; 1908, p. 159; 1911; Leng, 1920, p. 129; Leonard, 1928; Bowman, 1934, p. 58; Park, 1935, 1942, 1947, p. 66; Boving and Craighead, 1931, pl. 19, figs. G, H, I (LARVA).

Batrisus ferox LeConte, 1850, p. 95; Blatchley, 1910, p. 323; Park, 1947, p. 67.

Batrisus cristatus LeConte, 1850, p. 96; Park, 1947, p. 68.

Type locality: Athens, Clarke County, Georgia.

Range: New York and New Jersey, southward through Delaware, District of Columbia, Virginia, into Georgia; westward through Pennsylvania, Ohio, Indiana into Illinois.

monticola (Casey)

Batrisus monticola Casey, Bull. California Acad. Sci., vol. 1, 1886, p. 177; Casey, 1893, p. 469, 506.

Batrisodes monticola Leng, 1920, p. 129; Bowman, 1934, p. 60; Park, 1947, p. 108.

Type locality: El Dorado County, California.

nigricans (LeConte)

Batrisus nigricans LeConte, Boston Jour. Nat. Hist., vol. 6, 1850, p. 99; Brendel, 1866, p. 36; Henshaw, 1885, p. 29; Brendel, 1887, p. 204; G. H. Horn, in Brendel, 1887, fig. 3, p. 205, Brendel, and Wickham, 1890, p. 30, Casey, 1893, p. 506; Dury, 1903, 1908

Batrisodes nigricans Raffray, 1904, p. 204; 1908, p. 159; 1911; Blatchley, 1910, p. 328; Leng, 1920, p. 129, Bowman, 1934, p. 75; Park, 1947, p. 90.

Batrisodes spinifer (Brendel), 1887, p. 205, fig. 1, 2, Park, 1947, p. 92.

Batrisodes triangulifer (Brendel), 1890, p. 9, 28-30; Casey, 1893, p. 506, Leng, 1920, p. 129; C. W. Leng and A. S. Nicolay, in Leonard, 1928; Bowman, 1934, p. 74; Park, 1947, p. 91.

Type locality: South Carolina.

Range: South Carolina northward through Ocean County, New Jersey and Suffolk County, New York. A possible record (?) from Denver County, Colorado. See discussion in Park, 1947, p. 91.

occiduus (Casey)

Batrisus occiduus Casey, Bull. California Acad. Sci., vol. 1, 1886, p. 178; Brendel and Wickham, 1890, p. 17; Casey, 1893, p. 470, 506.

Batrisodes occiduus Raffray, 1904, p. 203; 1908, p. 159; 1911; Leng, 1920, p. 129; Bowman, 1934, p. 60; Park, 1947, p. 108.

Type locality: Humboldt County, California.

punctifrons (Casey)

Batrisus punctifrons Casey, Bull. California Acad. Sci., vol. 2, 1887, p. 463; Brendel and Wickham, 1890, p. 27; Casey, 1893, p. 506.

Batrisodes punctifrons Raffray, 1904, p. 204; 1908, p. 159; Leng, 1920, p. 129; Leonard, 1928; Bowman, 1934, p. 72; Park, 1947, p. 86.

Type locality: Pennsylvania.

Range: Mt. Toby, Massachusetts and Grafton County, New Hampshire southward through New York into Westmoreland County, Pennsyl-

pygidialis (Casey)

Batrisus pygidialis Casey, Ann. New York Acad. Sci., vol. 7, 1893, p. 470, 506.

Batrisodes pygidialis Raffray, 1904, p. 203; 1908, p. 159; 1911; Leng, 1920, p. 129; Bowman, 1934, p. 63; Park, 1947, p. 108.

Type locality: California.

riparius (Say)

Jour. Philadelphia Acad. Nat. Sci., vol. 4, 1824, p. 98.

Batrisus riparius LeConte, 1850, p. 97; Brendel, 1866, p. 36; Henshaw, 1885, p. 29; Brendel and Wickham, 1890, p. 19; Casey, 1893, p. 506; Dury, 1903.

Batrisodes riparius Raffray, 1904, p. 203; 1908, p. 159; 1911; Blatchley, 1910, p. 326; Leng, 1920, p. 129; Leonard, 1928; Bowman, 1934, p. 65; Park, 1935, 1942; 1947, p. 72.

?*Batrisus juvencus* Brendel, 1865, p. 258; 1866, p. 36; Bowman, 1934, p. 65; Park, 1947, p. 73.

Range: New York southward to Georgia; westward through Pennsylvania, Ohio, Indiana and Illinois, into Missouri.

rossi Park

Bull. Chicago Acad. Sci., vol, 8, 1947, p. 100.

Type locality: Herod, Pope County, Illinois.

sandersoni Park

Ibid., p. 97.

Type locality: Herod, Pope County, Illinois.

scabriceps (LeConte)

Batrisus scabriceps LeConte, Boston Jour. Nat. Hist., vol. 6, 1850, p. 98; Brendel, 1866, p. 36; Henshaw, 1885, p. 29; Brendel and Wickham, 1890, p. 19, pl. 10, fig. 86, pl. 12, fig. 138; Casey, 1893, p. 506; Wickham, 1896.

Batrisodes scabriceps Raffray, 1904, p. 203; 1908, p. 159; 1911; Leng, 1920, p. 129; Leonard, 1928; Bowman, 1934, p. 66; Park, 1935; 1947, p. 73.

Batrisodes harringtoni Casey, 1897, p. 578; Leng, 1920, p. 129; Bowman, 1934, p. 68; Brimley, 1942, p. 11; Park, 1947, p. 74.

Range: New York westward through Ottawa, Berrien County, Michigan, Bayfield County, Wisconsin into Johnson County, Iowa; south to Platte County, Missouri, Washington County, Arkansas, Illinois, Pennsylvania and Wake County, North Carolina.

schaefferi Park

Bull. Chicago Acad. Sci., vol. 8, 1947, p. 104.

Type locality: North Carolina.

schaumi (Aubé)

Batrisus schaumi Aubé, Ann. Soc. ent. France, vol. 2, 1844, p. 84; LeConte, 1850, p. 102; Henshaw, 1885, p. 29; Brendel and Wickham, 1890, p. 18, pl. 10, fig. 81, pl. 12, fig. 136; Casey, 1893, p. 506.

Batrisodes schaumi Raffray, 1904, p. 203; 1908, p. 159; 1911; Leng, 1920, p. 129; Leonard, 1928; Bowman, 1934, p. 63; Park, 1935; 1942, p. 17, pl. 2, fig. 3, 4; 1947, p. 71.

Batrisus punctatus LeConte, 1850, p. 97; Brendel, 1866, p. 36; Casey, 1893, p. 506; Leng, 1920, p. 129; Park, 1947, p. 72.

Range: New York westward to Berrien County, Michigan; southward through Illinois, Pennsylvania, Spotsylvania County, Virginia and Clarke County and White County, Georgia.

schmitti Casey

Ann. New York Acad. Sci., vol, 9, 1897, p. 581; Leng, 1920, p. 129; Bowman, 1934, p. 75; Park, 1947, p. 94.

Type locality: Westmoreland County, Pennsylvania.

Range: Westmoreland County, Pennsylvania south to North Carolina, and westward into Indiana.

***sinuatifrons* (Brendel)**

Batrisus sinuatifrons Brendel, Trans. Amer. Entom. Soc., vol. 20, 1893, p. 280, pl. 4, fig. 5; Casey, 1893, p. 506.

Batrisodes sinuatifrons Raffray, 1904, p. 204; 1908, p. 159; 1911; Leng, 1920, p. 129; Bowman, 1934, p. 73; Park, 1947, p. 88.

Type locality: Memphis, Shelby County, Tennessee.

Range: Shelby County, Tennessee westward to Lee County, Arkansas, and southward to Jefferson Parish, Louisiana.

***speculum* (Casey)**

Batrisus speculum Casey, Bull. California Acad. Sci., vol. 1, 1886, p. 176; Casey, 1893, p. 470, 506.

Batrisodes zephyrinus speculum Leng, 1920, p. 129.

Batrisodes speculum Bowman, 1934, p. 62; Park, 1947, p. 108.

Type locality: Alameda County, California.

***spretus* (LeConte)**

Batrisus spretus LeConte, Boston Jour. Nat. Hist., vol. 6, 1850, p. 100; Brendel, 1866, p. 36; Henshaw, 1885, p. 29; Brendel and Wickham, 1890, p. 26, pl. 10, fig. 92; Casey, 1893, p. 472, 506; Dury, 1903, 1908.

Batrisodes spretus Raffray, 1904, p. 204; 1908, p. 159; 1911; Blatchley, 1910, p. 327; Leng, 1920, p 129; Notman, 1920, p. 180; Leonard, 1928; Bowman, 1934, p. 70; Park, 1947, p. 84.

Type locality: White County, Georgia.

Range: Vermont southward through Broome County, New York, Cumberland County, Pennsylvania, Virginia, to White County, Georgia; westward into Illinois.

***striatus* (LeConte)**

Batrisus striatus LeConte, Boston Jour. Nat. Hist., vol. 6, 1850, p. 99; Casey, 1893, p. 472, 106.

Batrisodes striatus Raffray, 1904, p. 204; 1908, p. 159; 1911; Leng, 1920, p. 130; Leonard, 1928; Bowman, 1934, p. 76; Park, 1947, p. 95.

Batrisus simplex LeConte, 1878, p. 598; Casey, 1893, p. 472; Park, 1947, p. 95.

Batrisus aterrimus Casey, 1884, p. 91; 1893, p. 472; Park, 1947, p. 95.

Batrisus cephalotes Casey, 1887, p. 459; 1893, p. 472; Park, 1947, p. 95.

Type locality: Pennsylvania.

Range: Middlesex County, Massachusetts westward through Ontario, Michigan and northern Illinois to Wallace County, Kansas; southward through New York, New Jersey, Rhode Island, District of Columbia into Georgia.

***striatus psotai* Park**

Bull. Chicago Acad. Sci., vol. 8, 1947, p. 105.

Type locality: Antioch, Lake County, Illinois.

temporalis Casey

Ann. New York Acad. Sci., vol. 9, 1897, p. 573, Leng, 1920, p. 129; Bowman, 1934, p. 66; Park, 1947, p. 75.

Type locality: Westmoreland County, Pennsylvania.

tridens Casey

Canadian Entom., vol. 40, 1908, p. 263; Leng, 1920, p. 129; Bowman, 1934, p. 75; Park, 1947, p. 96.

Type locality: St. Louis, Missouri.

tulareanus Casey

Ibid., 1908, p. 261; Leng, 1920, p. 129; Bowman, 1934, p. 61; Park, 1947, p. 108.

Type locality: Tulare County, California.

uncicornis Casey

Ann. New York Acad. Sci., vol. 9, 1897, p. 576; Leng, 1920, p. 129; Leonard, 1928; Bowman, 1934, p. 65; Brimley, 1942, p. 11; Löding, 1945, p. 42; Park, 1947, p. 73.

Type locality: Vicinity of New York City, New York.

Range: New York southward to Wake County, North Carolina; possibly into Mobile and Baldwin Counties, Alabama.

virginiae (Casey)

Batrisus virginiae Casey, Contrib. Col. N. Amer., 1884, pt. 2, p. 90; Henshaw, 1885, p. 29; Brendel and Wickham, 1890, p. 25, pl. 12, fig. 139; Casey, 1893, p. 506; Dury, 1903, 1908.

Batrisodes virginiae Raffray, 1904, p. 204; 1908, p. 159; 1911; Leng, 1920, p. 129; Bowman, 1934, p. 72; Brimley, 1938, p. 148; Park, 1947, p. 87.

Type locality: Stone Creek, Lee County, Virginia.

Possible range: Lee County, Virginia southward to Round Knob, North Carolina; westward through Hamilton County, Ohio into southern Indiana.

zephyrinus (Casey)

Batrisus zephyrinus Casey, Bull. California Acad. Sci., vol. 1, 1886, p. 175; Brendel and Wickham, 1890, p. 13, pl. 10, fig. 82, pl. 12, fig. 141; Casey, 1893, p. 470, 506.

Batrisodes zephyrinus Raffray, 1904, p. 203; 1908, p. 159; 1911; Leng, 1920, p. 129; Bowman, 1934, p. 62; Park, 1947, p. 108.

Type locality: Reno, Washoe County, Nevada.

NEOTROPICAL REGION

At the present time there are no authentic species of *Batrisodes* known from the Neotropical Region.

Schaufuss (1887, p. 146) described *Batrisus asteriscus* from Bogota, Colombia. Raffray (1897) examined the type of this species, found the unique specimen to be damaged, and placed it in *Batrisus* with doubt. This species was said to agree with *Batrisodes* in the structure of the carinal pattern of the sides of the abdomen, rather than with *Batrisus*, and Raffray (1904) assigned *asteriscus* to the former genus with reservation. A few years later, Raffray (1908) again questioned this allocation.

In his world checklist of the family, Raffray (1911) did not go into the questionable nature of the case, and listed the species as *Batrisodes asteriscus.* This course was followed by Blackwelder (1944, p. 92).

No additional specimens of *asteriscus* have been reported, and Raffray (1923-1924) in his faunal analysis did not list *asteriscus.* The author is of the opinion that this is the best course to follow. For the present *asteriscus* must remain unknown, and all subsequent collections reported from the neotropics have not included the species. It can not be placed in *Iteticus* on its pronotal sculpture and its reported anatomy does not fit that of any other neotropical genus (Park, 1942).

In view of the recent discussion of *Batrisodes* (Park, 1947), any specimens in either *Batrisodes* or *Iteticus* from the Neotropical Region would be of considerable interest.

ABSTRACT

The pselaphid genus *Batrisodes* contains 214 species known at present. These are distributed as follows: Palaearctic 41, Nearctic 52, Ethiopian 4, Neotropical 0, Oriental 83, and Australian 34.

The species are listed alphabetically for each region or area, together with citations, synonyms, type locality and range where such details are known.

Batrisodes arthuri nom. nov. is proposed for *Batrisodes punctifrons* Lea (1911) of Australia since the latter is preoccupied by *Batrisodes punctifrons* (Casey), 1887, of Pennsylvania.

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Bulletin
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A Preliminary Key to the Genera of Clavarioid Fungi

MAXWELL S. DOTY

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The Bulletin of the Chicago Academy of Sciences was initiated in 1883 and volumes 1 to 4 were published prior to June, 1913. During the following twenty-year period it was not issued. Volumes 1, 2, and 4 contain technical or semi-technical papers on various subjects in the natural sciences. Volume 3 contains museum reports, descriptions of museum exhibits, and announcements.

Publication of the *Bulletin* was resumed in 1934 with volume 5 in the present format. It is now regarded as an outlet for short to moderate-sized original papers on natural history, in its broad sense, by members of the museum staff, members of the Academy, and for papers by other authors which are based in considerable part upon the collections of the Academy. It is edited by the Director of the Museum with the assistance of a committee from the Board of Scientific Governors. The separate numbers are issued at irregular intervals and distributed to libraries and scientific organizations, and to specialists with whom the Academy maintains exchanges. A reserve is set aside for future need as exchanges and the remainder of the edition offered for sale at a nominal price. When a sufficient number of pages have been printed to form a volume of convenient size, a title page, table of contents, and index are supplied to libraries and institutions which receive the entire series.

Howard K. Gloyd, Director of the Museum

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Bulletin of the Chicago Academy of Sciences

A Preliminary Key to the Genera of Clavarioid Fungi

MAXWELL S. DOTY[1]

The fungi to be treated here are basidiomycetes whose fructifications are erect from their substratum and are, in form, simple clubs or more or less branched structures. The hymenium layer covers all the upper surfaces as a rule; though occasionally it is unilateral or the apex of the fructification may be sterile. The substratum may be soil, humus, wood or undecomposed plant debris. There is evidence that some of the species are mycorhizal. While the larger clavarioid fungi are almost all fleshy in the sense that a mushroom is of fleshy consistency, some of the smaller species are tough or woody. Though they are all edible if palatable[2], usually they are not found in sufficient quantities to make them sought for as food

In pursuing a study of the fungi generally allocated to the genus *Clavaria* and to the family Clavariaceae, the present author has been surprised to find only some half dozen species reported from the state of Illinois. In the neighboring tier of states some three to four dozen species are known. Because of situations such as this no attempt is being made at this time to enumerate *species* but to assist individuals who may collect clavarioid fungi tentative keys to the species known to occur in North America have been prepared. These are under constant revision in typewritten or mimeographed form, and so, while it is hoped they are sometimes helpful to their users, they are not yet worthy of publication. However, to promote study of this group, this paper has been prepared as a key to those *genera* one may expect

[1]Department of Botany, Northwestern University.

[2]As far as the author knows there is only one report of poisoning by a member of this group. Roger Heim (11) reported, "*Clavaria formosa* n'est pas comestible; il n'exerce aucune action sur l'estomac, mais agit su l'intestine comme un purgatif."

to find in North America. The numbers in parentheses after each generic name in the key refer to the publications in the list at the end of this paper. These so-designated publications deal with the species of that particular genus in North America, and nearly all the recognized species of all but the more obscure genera, such as *Pistillina*, are covered in these references.

Several of the works cited contain keys to the species but none of them has all the species in the genera as differentiated by the following key. Fries (10) original "family Clavariaceae" contained various of the ascomycetes and fungi imperfecti now excluded. Some workers contemporary to Fries and many workers since have treated his genus, *Clavaria*, as a number of groups that in themselves seem to merit distinction as separate genera. It is hoped that this synoptic artificial key will indicate more or less the relationships among the genera and yet be useful. Some genera of the Hydnaceae (15) and of the Tremellales (14) are of clavarioid form, but while they are basidiomycetes, they are arbitrarily excluded from this treatise.

KEY TO THE NORTH TEMPERATE GENERA OF CLAVARIOID FUNGI

1 Spores hyaline (rarely tinted), mostly smooth and thin-walled; basidia 2- or 4-spored:
  2 Fructifications lamellate *Sparassis* (17).
  2′ Fructifications not lamellate:
    3 Spores large (7 microns or over), globose; basidia 2-spored; hymenium white or gray; not staining green with $FeSO_4$ [3]:
      4 Fleshy putrescent throughout; no distinct stem portion *Clavulina* (5, 6, 8, 17).
      4′ Toughish to woody, at least below; with a distinct stem portion LACHNOCLAVULINA section of *Clavulina* (5, 6, 8).
    3′ Spores distinctly smaller than above or ellipsoid; basidia typically 4-spored if spores spherical; hymenium often colored otherwise or staining green with $FeSO_4$:
      5 With stout hyphae in the trama producing setae or gloeocystidia in the hymenium or subhymenium, or the apices of branches truncate or cup-shaped; spores under 8 microns long; not staining green with $FeSO_4$:
        6 Apices of some branches truncate to cup-shaped; with gloeocystidia in the hymenium layer *Clavicorona* (9).
        6′ Apices of branches acute; with strong setae in the hymenium or subhymenium *Eriocladus* (4).

[3] A 10% aqueous solution applied to the surface dropwise with a medicine dropper. The reaction takes place within about 30 seconds.

5′ Without such hyphae or apices; spores various; or staining green with $FeSO_4$:
7 Fructifications branched:
8 Finely branched (often under 1 mm.); toughish *Pterula* (13).
8′ Branches larger; flesh fragile or putrescent:
9 Hymenium green with $FeSO_4$ *Clavariella p. p.* (5, 6, 8, 17).
9′ Hymenium not green with $FeSO_4$ *Clavaria p. p.* (5, 6, 8, 17).
7′ Fructifications simple or rarely branched once above:
10 Fructifications enlarged above or over 1 cm. in diameter above; spores elliptic:
11 Minute (not over 5 mm. tall); or with an abruptly inflated head; not green with $FeSO_4$:
12 With an inflated down-turned head *Physalacria* (1, 2).
12′ With the apex merely enlarged:
13 Hymenium on the expanded blunt apex *Pistillina* (17).
13′ Hymenium on the sides of the club *Pistillaria p. p.* (17, 5).
11′ Large (over 2 cm. tall); or turning green with $FeSO_4$ *Clavariadelphus* (5, 6. 8, 17).
10′ Fructifications not enlarged above (i. e., slenderly clavate to filiform clubs); spores various:
14 Fructifications over 2 cm. tall; not obviously restricted to specific hosts or substrata, or the fructifications fascicled fleshy forms; often with globose spores:
15 Tramal hyphae with many secondary crosswalls; clamp connections rare *Clavaria p. p.* (5, 6, 8, 17).
15′ Tramal hyphae with secondary crosswalls only rarely; clamp connections on most crosswalls *Clavulinopsis* (5, 6, 8, 17).

14′ Fructifications smaller; restricted to specific hosts or substrata which may be sclerotia or living organisms; spores elliptical or flattened on one side:

16 Algal "symbionts," narrowly clavate; mostly on rather bare soil; without a sclerotial base *Gliocoryne* (6, 7, 8).

16′ Not algal "symbionts," filiform or under 2 mm. tall; mostly on dead plant materials:

17 With a sclerotial base; stipe slender and distinct; mostly over 5 mm. tall *Typhula* (18).

17′ Without a sclerotial base; stipe not distinct; mostly less than 2 mm. tall *Pistillaria p. p.* (6, 17).

1′ Spores typically ochraceous, mostly roughened or obdurate-walled[4]; basidia 4-spored, rarely otherwise:

18 Toughish to woody; spores echinate or sharply warty; hymenium sometimes unilateral; not becoming green with $FeSO_4$:

19 Coarse, leathery to woody fungi; hymenium often unilateral or branches flattened *Thelephora* (12).

19′ Delicate, toughish to woody fungi; hymenium covering all surfaces of the rounded branches *Scytinopogon* (19).

18′ Fleshy; spores smooth, verrucose to echinulate; hyenium on all lateral surfaces of the branches; becoming green with $FeSO_4$:

20 Simple unbranched fungi with broadened sterile apices; sometimes "mushroom-like" in form *Gomphus p. p.* (3, 6, 8, 16, 17).

20′ Branched fungi; "coralloid" in form *Clavariella p. p.* (5, 6, 8, 17).

[4]In practice, Clavarioid fungi with spores which under the microscope display walls of appreciable (more than 0.5 microns) thickness, obvious ornamentation or color are placed here.

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New and Little Known *Reichenbachia* (Coleoptera: Pselaphidae) from Guerrero, and their Zoogeographic Integration

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The Bulletin of the Chicago Academy of Sciences was initiated in 1883 and volumes 1 to 4 were published prior to June, 1913. During the following twenty year period it was not issued. Volumes 1, 2, and 4 contain technical or semi technical papers on various subjects in the natural sciences. Volume 3 contains museum reports, descriptions of museum exhibits, and announcements

Publication of the *Bulletin* was resumed in 1934 with volume 5 in the present format. It is now regarded as an outlet for short to moderate-sized original papers on natural history, in its broad sense, by members of the museum staff, members of the Academy, and for papers by other authors which are based in considerable part upon the collections of the Academy. It is edited by the Director of the Museum with the assistance of a committee from the Board of Scientific Governors. The separate numbers are issued at irregular intervals and distributed to libraries and scientific organizations, and to specialists with whom the Academy maintains exchanges. A reserve is set aside for future need as exchanges and the remainder of the edition offered for sale at a nominal price. When a sufficient number of pages have been printed to form a volume of convenient size, a title page, table of contents, and index are supplied to libraries and institutions which receive the entire series.

Howard K Gloyd, Director of the Museum

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Bulletin
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New and Little Known *Reichenbachia* (Coleoptera: Pselaphidae) from Guerrero, and their Zoogeographic Integration

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CONTENTS

INTRODUCTION

The occasion for this paper is an analysis of a small but very interesting collection of pselaphids made by Dr. Dwight M. DeLong, of Ohio State University. The beetles were taken at light on the night of October 22, 1941, at Chilpancingo, Guerrero, Mexico.

Dr. DeLong sent the specimens to Dr. Milton W. Sanderson, of the Illinois Natural History Survey, who in turn gave them to me. I wish to thank both of these gentlemen for their kindness. The type specimen of a new species, described in this article, is in the collection of the author.

Whereas any increment to our knowledge of Mexican pselaphids is most welcome, information on the fauna of the Pacific Slope is especially desirable in view of the great relative paucity of data. The zoögeographic bearing of this collection is discussed later.

Reichenbachia biocellata **(Schaufuss)**

Redescription. Male. Measurements: head 0.37 mm. long (labral suture to temporal angles) x 0.39 mm. wide (through eyes); pronotum 0.42 mm. x 0.47 mm.; elytra 0.60 mm. x 0.87 mm.; abdomen 0.37 mm. x 0.77 mm.; total length 1.76 mm.

Uniform yellowish brown. Flavous pubescence very short and inconspicuous. Integuments polished, very inconspicuously punctulate.

Head with prominent eyes and normally convex vertex; trifoveate; the frontal fovea, between the antennal tubercles, slightly inclined, elongate, with the posterior portion densely pubescent; vertexal foveae relatively very abnormal, of tremendous size, each fovea about one-fourth of the total head width in diameter (0.10 mm.), deep, with dense foveal pubescence; frontoclypeus declivous, medianly narrowed between large antennal cavities, simple, bearing longer setae; mandibles simple, not bearing teeth on the external rami; ventral surface of head and maxillary palpi as for genus. Pl. I, 1.

Antennae eleven-segmented, abnormal; segment I elongate; II slightly longer than wide, slightly narrower than first; III obconical, narrower than second; IV elongate, longer than third, subequal to third in width; V elongate, slightly more than twice as long as wide, distinctly longer than fourth; VI elongate, almost three times as long as wide, distinctly longer than fifth; VII slightly longer than wide, about as long as third; VIII smallest segment, quadrate; IX and X simple, obtrapezoidal, progressively larger; XI simple, wider than tenth and about as long as eighth, ninth, and tenth segments united. Pl. 1, 2.

Pronotum normal for the genus, with a small, elongate, nude median basal fovea, and a pair of circular, larger, pubescent antebasal foveae. These lateral antebasal foveae appear smaller by contrast with the excessively large vertexal foveae, although they are normal in size, each fovea having a diameter of 0.06 mm.

Elytra trifoveate; sutural stria entire; discal stria long, arcuate, extending to apical three-fourths.

Basal abdominal carinae of first visible tergite short and widely separated, one-seventh of the segmental length and separated by one-third of the segmental width. Metasternum medianly tumid, the tumidity flattened and bisected by a longitudinal sulcoid impression. Legs simple.

Redescribed on a male specimen taken from Chilpancingo, Guerrero, Mexico, at 4100 feet elevation, at light, October 22, 1941 by Dr. Dwight M. DeLong.

Reichenbachia biocellata (Schaufuss) is a member of Group XLI. The finding and allocation of this species is specially gratifying since it reduces to four the number of species of *Reichenbachia* known from Mexico but not keyed out or allocated to generic groups (Park, 1945, p. 385). This species was described briefly by Schaufuss (1887, p. 127) from Mexico, without further locality. Raffray (1904) did not know *Bryaxis biocellata* Schaufuss, and assigned it with great doubt to the genus *Reichenbachia*, but without group allocation. This course was followed by Park (1942, 1944, p. 256, 1945).

The Chilpancingo record places *biocellata* in the Sierra Madre del Sur physiographic region of Hoy (1943). In terms of the biotic provinces of Smith (1940), based on the distribution of lizards of the genus *Sceloporus*, *biocellata* is known at present from the upper limit of the Lower Balsan province, where the nearctic Guerreran merges with the neotropical Lower Balsan.

Reichenbachia reichei (Schaufuss)

This is one of the better known species of the neotropical fauna. It was described briefly as *Bryaxis reichei* by Schaufuss (1872, p. 264) from Colombia and Guatemala, and later reported again from San Gerónimo, Guatemala by Sharp (1887, p. 27). It was allocated to Group LIII of *Reichenbachia* by Raffray (1904). The male sex was redescribed, and male antenna figured by Park (1944. p. 240, Pl. II, fig. 8), on a male taken at light at Acapulco, Guerrero, Mexico. The range of the species was extended by Park (1945, p. 365) from several additional Pacific Slope localities in Mexico, and the female sex described for this species. These additional records are from Tonalá, Chiapas at 120 feet elevation; Huetamo, Michoacán, bordering on Guerrero, near the Rio Balsas; Cuautla, Morelos at 3600 feet elevation.

The DeLong collection contained six specimens of *reichei* from Chilpancingo, Guerrero at 4100 feet.

From these several records it is possible to draw several conclusions regarding *reichei* in Mexico. (1) The species is a member of the Neotropical fauna. (2) It is restricted to the Pacific Slope area as discussed previously (Park, 1943, p. 207-216, Pl. III). (3) It has a known altitude range from sea level to 4100 feet. (4) It is nocturnal in its normal activity pattern. (5) Its known seasonal range based on records of adults flying to lights at night, is from August 22 to December 8. These

records are December 8, 1932 (Tonalá, Chiapas); August 22 1933 (Huetamo, Michoacán); September 2, 23. and 25, 1937 (Cuautla, Morelos); August 28, 1938 (Acapulco, Guerrero); October 22, 1941 (Chilpancingo, Guerrero). (6) Its range is from southern Michoacán to the center of the coast of Chiapas, in Mexico, as well as the older records from Guatemala and Colombia. In its Mexican range, *reichei* is known from the Lower Balsan and Tapachulan provinces of Smith (1940), the only gap being lack of records from the intermediate Tehuantepecan province along the coast of Oaxaca (Fig. 1).

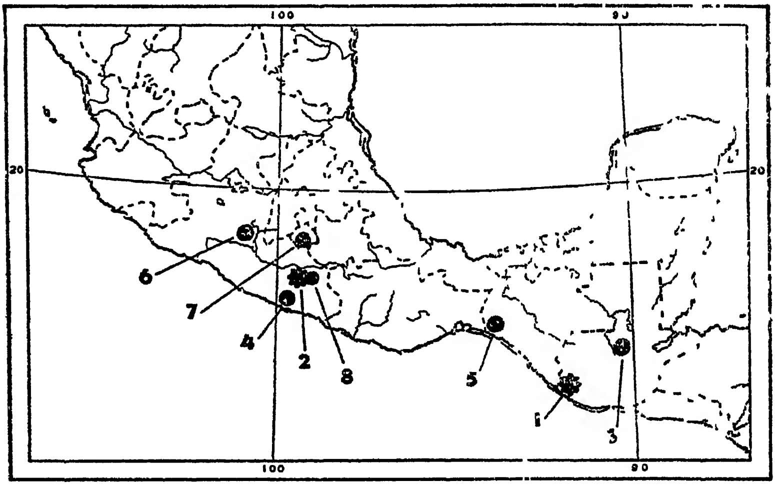

Figure 1. Known distribution of *Reichenbachia bicuspida* Park and *Reichenbachia reichei* (Schaufuss) in Mexico and Guatemala.

bicuspida: 1. Puerto de Ocos, Guatemala; 2. Chilpancingo, Guerrero.

reichei: 3. San Geronimo, Guatemala; 4. Acapulco, Guerrero; 5. Tonalá, Chiapas; 6. Huetamo, Michoacán; 7. Cuautla, Morelos; 8 Chilpancingo, Guerrero.

Scale: 1 inch, 400 miles.

Reichenbachia bicuspida Park

This species is a member of Group LIV, known previously from Puerto de Ocos, Guatemala (Park, 1945, p. 368). This locality is just over the border from Chiapas, in the Pacific coastal extension of the Mexican Tapachulan province of Smith (1940).

A second record of this species is added now by a single male in the DeLong collection, from Chilpancingo, Guerrero at 4100 feet elevation.

This is another instance in which the same species of the genus is known from the Lower Balsan and Tapachulan provinces (Fig. 1).

***Reichenbachia delongi* new species**

Type. Male. Measurements: head 0.38 mm. long (labial suture to occiput) x 0.42 mm. wide (through eyes); pronotum 0.39 mm. x 0.47 mm.; elytra 0.56 mm. x 0.87 mm; abdomen 0.47 mm x 0.80 mm.; total length 1.8 mm.

Reddish brown with paler elytra and palpi. Flavous pubescence moderately long and conspicuous. Integuments polished and inconspicuously punctulate.

Head (Pl. I, 3) with prominent eyes and normally convex vertex; bifoveate; frontal fovea absent; vertexal foveae of normal size, pubescent, mutually twice as far apart as either from its adjacent eye. Frontoclypeus complex: steeply declivous between antennal articulations, with a pair of shallow, remote depressions on the subvertical, pubescent frontal wall; suddenly flattened apicoventrad of this declivity, with the lateral margins of this flattened area carinoid and becoming gradually thicker and elevated to form a pair of clypeal tubercles; this flattened area becoming declivous to form a sinus between the clypeal tubercles; clypeus subvertically declivous from this flattened, tuberculated area to form a well-defined clypeal margin; labrum simple; each mandible with a prominent tooth on the external ramus; ventral surface of head and maxillary palpi as for genus.

Antennae abnormal (Pl. I, 4). Segment I elongate; II very large and abnormal, distinctly longer and wider than first, longitudinally ovate with the ventral face flattened, the flattened surface bearing a foveoid depression at apicomesial fourth; III obconical, half as long as second; IV elongate, slightly shorter than third; V very abnormal, longitudinally ovate from dorsal face, mesial face swollen, ventral face irregularly obtrapezoidal with a prominent, hirsute tubercle as apex; VI smaller than fourth, slightly longer than wide, with hirsute ventral face slightly produced; VII slightly longer than sixth; VIII subquadrate, similar to sixth in size; IX, X and XI forming the usual club, with the ninth segment less obtrapezoidal than usual, and subcylindrical.

Pronotum normal for genus, with the usual minute, circular, nude, median basal fovea, and a pair of larger, pubescent, antebasal lateral foveae.

Elytra trifoveate, with entire sutural stria and discal stria long, arcuate, extending to apical three-fourths.

Abdomen with first two tergites normally margined; basal abdominal carinae of first tergite short and distant as described for *biocellata*.

Metasternum medianly broadly concave.

First visible and last sternite medianly flattened to concave.

Mesocoxae each with a long, straight, acute spine extending from mesioventral face. Mesotibiae each with a short, triangular cusp at apex of ventral face. Metatibiae normal, neither tumid nor modified.

Described on one male, the type specimen, taken at light, October 22, 1941, at Chilpancingo, Guerrero, Mexico, at 4100 feet elevation by Dr. Dwight M. DeLong, in whose honor the species is named.

This new species is a member of Group LV, and within this group is discriminated quickly by its abnormal second antennal segment.

ZOOGEOGRAPHIC AFFINITIES OF THE GUERRERAN FAUNA

At the present time there are 42 species, subspecies and varieties of *Reichenbachia* recorded from Mexico and Guatemala. Of these 29 are known from the better-collected Mexico, 6 are known from Guatemala, whereas only 7 are reported from both countries (Table I), although Mexico and Guatemala have a relatively homogeneous pselaphid fauna.

Of the species listed in the preceding table, only four are unallocated to intrageneric groups. This suggests that the taxonomy of *Reichenbachia* in the Mexico-Guatemala area is relatively sound. On the other hand, the number of new species that continue to be present in modern collections suggests that our knowledge of this relatively well-known genus is far from complete. This is especially true of Guatemala.

Consequently, zoögeographic conclusions are tentative, but certain interesting features are suggested when the fauna is separated on a geographic, rather than a political basis (Table II).

The 30 species, subspecies, and varieties listed in this second table represent those neotropical forms for which definite locality data are available. In addition, there are four species known only from "Mexico" (*grouvellei, impunctata, irrita* and *luteola*); four known from localities in Guatemala that have not been satisfactorily located (*?crassipalpis, designata, diversicornis* and *?impubis*); the small Nearctic component of three species (*netteli, pubescens,* and *sonorensis*); and the doubtfully discriminated *sallaei*.

The position of the last named species is uncertain. Sharp (1887, p. 27) described *Bryaxis sallaei* from a series of specimens taken in Mexico (Cordoba, Veracruz), Guatemala (Cerro Zunil at 4000 to 5000

TABLE 1

REICHENBACHIA OF MEXICO AND GUATEMALA

	Known only from Mexico	Known only from Guatemala	Known from both countries
a. appendiculata Raffray	x		
bicuspida Park			x
bifoveata Fletcher	x		
biocellata (Schaufuss)	x		
carinifer Fletcher	x		
celata (Sharp)			x
? *crassipalpis* (Sharp)		x	
d. dampfi Park	x		
d. obsoleta Park	x		
delongi new species	x		
dentisterna Park	x		
designata (Sharp)		x	
diversicornis (Sharp)		x	
diversula Raffray	x		
f. falsa Raffray	x		
f. pipa Park	x		
grouvellei Raffray	x		
guatemalensis Fletcher			x
guerrensis Park	x		
? *impubis* (Sharp)		x	
impunctata (Schaufuss)	x		
intacta (Sharp)		x	
irrita Raffray	x		
jaliscoensis Park	x		
juxtairrita Park	x		
latipes Fletcher	x		
luteola Raffray	x		
mexicana Raffray	x		
netteli Park	x		
nominata (Sharp)			x
obnubila Raffray	x		
pacifica Park	x		
parviceps (Sharp)			x
phantasmoidea Park	x		
pubescens (Schaufuss)	x		
quotuma Park	x		
reichei (Schaufuss)			x
sallaei (Sharp)			x
sarcinaria (Schaufuss)	x		
serapha Park		x	
sonorensis Park	x		
vinusqua Park	x		

feet, and Senahu), and Panama (Volcan de Chiriqui at 2000 to 3000 feet). Raffray (1904) placed the species in Group XL of *Reichenbachia.* This allocation was followed by Raffray (1908 1911) and Park (1942, 1943). More recently (Park, 1945) new material was reported from three localities in Chiapas (Maravillas, Mazatan, Suchiate), and from Guatemala (Retalhuleu). The male and female sexes were redescribed from this material and *sallaei* reallocated to Group XLVII. This reallocation was tentative. It may be that *sallaei* Park, 1945 is not *sallaei* (Sharp), 1887, and that these reallocated specimens represent a new species. The matter is mentioned here since the Sharp record in Veracruz is an Atlantic Coastal locality, whereas the records from Chiapas and Retalhuleu, Guatemala are Pacific Coastal localties. To date, *sallaei* is the only species of *Reichenbachia* reported from both coasts without infraspecific differentiation of the population. For the present Sharp's poorly known species has been left out of the lists in the second table.

Consequently, of the 42 kinds of *Reichenbachia* reported from Mexico and Guatemala, 33 may be assigned to a provisional zoögeographic area.

In the first place, this fauna is overwhelmingly neotropical: only three Nearctic species as opposed to 30 Neotropical species. This ratio may be the result of differential collecting, and the size of the Central Mexican Plateau would seem to suggest that this might be the case. This is not the author's view. Although new species of nearctic *Reichenbachia* are to be anticipated, probably the number of undescribed neotropical forms is much greater.

The family as a whole is preponderantly tropical and subtropical (Park, 1942, 1947 a, b), predaceous, and ecologically associated with forest floor leaf mold with its abundant food stores of mites and other small arthropods. Therefore it is more likely that the small number of nearctic *Reichenbachia* in Mexico is an indirect consequence of the increasing aridity of the Central Plateau.

Second, on the basis of present information, the species of *Reichenbachia* in Mexico and Guatemala appear to be separated into three basic zoögeographic areas. These are the Central Plateau, the Atlantic Slope, and the Pacific Slope. The Central Plateau is Nearctic, ranges from 3000 to 9000 feet in elevation, and is more or less fringed and dissected by the Sierra Madre Oriental and the Sierra Madre Occidental. The Atlantic Slope and Pacific Slope are Neotropical, at least as far north as the Tropic of Cancer.

These three areas have been proposed for Mexican pselaphids in general (Park, 1943, p. 207-216, Pl. III), and the greatly augmented data on *Reichenbachia* support this general view.

TABLE II

MAJOR SEPARATION OF NEOTROPICAL REICHENBACHIA IN MEXICO-GUATEMALA

Atlantic Drainage Slope	Pacific Drainage Slope
a. appendiculata	*bicuspida*
bifoveata	*biocellata*
carinifer	*dampfi obsoleta*
celata	*delongi*
d. dampfi	*guerrensis*
dentisterna	*jaliscoensis*
diversula	*mexicana*
f. falsa	*nominata*
f. pipa	*pacifica*
guatemalensis	*reichei*
intacta	*serapha*
juxtairrita	*vinusqua*
latipes	
obnubila	
parviceps	
phantasmoidea	
quotuma	
sarcinaria	

Third, the populations of *Reichenbachia* of the two Neotropical Slopes are disparate from each other. Presumably, dispersal between these two areas would be feasible across the relatively narrow, low Isthmus of Tehuantepec but there are no reliable data to support such movements. Instead, the two faunas are distinct. Where the same species occurs on both the Atlantic and Pacific coastal regions, there is subspeciation into an Atlantic and Pacific coastal subspecies, as in the case of the Atlantic *dampfi dampfi* and its Pacific counterpart, *dampfi obsoleta*.

In fact, *Reichenbachia* of the Pacific Slope of Neotropical Mexico are much more similar to those of the Pacific Slope of Guatemala than to species of the Atlantic Slope of Neotropical Mexico, and *vice versa*. For example, *bicuspida, nominata,* and *reichei* are known from several Pacific Slope localities of Mexico and Guatemala, and *celata, guatemalensis*, and *parviceps* are recorded from several Atlantic Slope localities of these two countries.

Fourth, where sufficient data have been accumulated, species of this genus have been found in several states, and in two to three contiguous biotic provinces of Smith (1940) in both the Atlantic and Pacific Slope faunas. This would appear to indicate that species of

Reichenbachia have larger ranges than species and subspecies of *Sceloporus* lizards.

Fifth, the Guerreran fauna is typical of the Neotropical Pacific slope, and contains at least seven species: *bicuspida, biocellata, delongi, guerrensis, mexicana, pacifica,* and *reichei.*

SUMMARY

Three previously described species of *Reichenbachia, biocellata* (Schaufuss), *bicuspida* Park, and *reichei* (Schaufuss) are reported from Chilpancingo, Guerrero, Mexico at 4100 feet elevation.

Reichenbachia delongi new species is described from the same locality.

Reichenbachia known from Mexico and Guatemala are listed and their zoögeography discussed.

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PLATE I

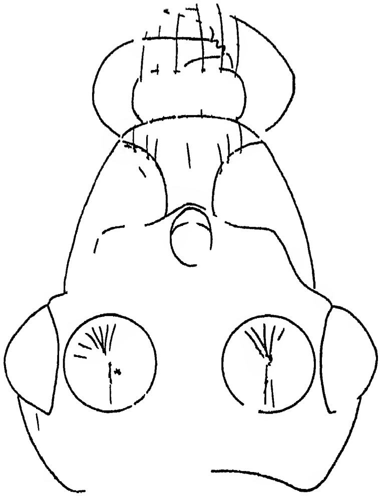
1. *Reichenbachia biocellata* (Schaufuss), male, dorsal view of head.

2 *R biocellata* (Schaufuss), male, first seven antennal segments, dorsal view.

3. *R delongi* new species, male type, dorsal view of head.

4. *R delongi* new species, first six antennal segments, dorsal view.

5. *R delongi* new species, mesial view of fifth antennal segment.



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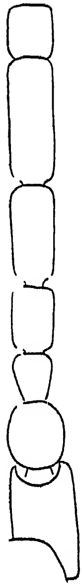

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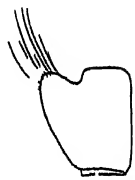

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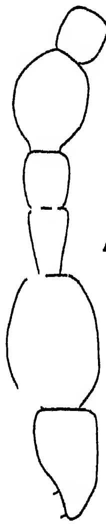

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Vol. 8 No. 7

Bulletin
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New Records for Amphibians and Reptiles in the Chicago Area, 1939-1947

W. T. Stille and Richard A. Edgren, Jr.

Chicago
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1948

The Bulletin of the Chicago Academy of Sciences was initiated in 1883 and volumes 1 to 4 were published prior to June, 1913. During the following twenty year period it was not issued. Volumes 1, 2, and 4 contain technical or semi-technical papers on various subjects in the natural sciences. Volume 3 contains museum reports, descriptions of museum exhibits, and announcements.

Publication of the *Bulletin* was resumed in 1934 with volume 5 in the present format. It is now regarded as an outlet for short to moderate-sized original papers on natural history, in its broad sense, by members of the museum staff, members of the Academy, and for papers by other authors which are based in considerable part upon the collections of the Academy. It is edited by the Director of the Museum with the assistance of a committee from the Board of Scientific Governors. The separate numbers are issued at irregular intervals and distributed to libraries and scientific organizations, and to specialists with whom the Academy maintains exchanges. A reserve is set aside for future need as exchanges and the remainder of the edition offered for sale at a nominal price. When a sufficient number of pages have been printed to form a volume of convenient size, a title page, table of contents, and index are supplied to libraries and institutions which receive the entire series.

Howard K. Cloyd, Director of the Museum

Committee on Publications:

Vol. 8, No. 7 August 27, 1948

Bulletin of the Chicago Academy of Sciences

New Records for Amphibians and Reptiles in the Chicago Area, 1939-1947

W. T. STILLE AND RICHARD A. EDGREN, JR.[1]

In the nine years since the publication of Walter Necker's paper, "Records of Amphibians and Reptiles of the Chicago Region, 1935-1938" (1939), further collecting has made available numerous additional records. Necker not only included new county records but also additional ones from localities recorded by Schmidt and Necker (1935). The present list has been compiled only of new county records based on material in the collections of the Chicago Academy of Sciences, the Chicago Natural History Museum, Northwestern University, and our personal collections.[2] For the sake of completeness, we have included data recorded elsewhere (Edgren, 1944, Stille, 1947, and other reports from the literature).

A large portion of this material was utilized by Clifford H. Pope in the preparation of his book on the amphibians and reptiles of the Chicago Area (1944). Inasmuch as full locality data could not in many instances be recorded, it seems of value to repeat such records here.

Swanson (1939) has published on material collected by him in the Jasper-Pulaski Game Preserve in Indiana. This preserve is divided by the Jasper-Pulaski county line. Jasper county is a portion of the Chicago Area, Pulaski County is not. Since no part of the preserve is more than three miles from the Jasper County line, all records from the preserve are considered to be from Jasper County. Swanson's work has added two species to the area's list: *Ambystoma texanum* and *Plethodon glutinosus*.

[1] Roosevelt College and Northwestern University.

[2] The abbreviations used are as follows: CA—Chicago Academy of Sciences; CNHM—Chicago Natural History Museum (formerly the Field Museum of Natural History); NU—Northwestern University; UMMZ—University of Michigan, Museum of Zoölogy; WTS and RAE—our own personal collections.

The present list increases the total number of county records by more than one third, and is based on more than three thousand specimens, roughly doubling the material available to previous workers.

We express our gratitude to the following persons for permission to examine the collections under their care: Dr. Howard K. Gloyd, Chicago Academy of Sciences; Dr. Orlando Park, Northwestern University; Clifford H. Pope and Karl P. Schmidt, Chicago Natural History Museum; and Dr. Norman E. Hartweg, University of Michigan, who kindly supplied us with a list of Berrien County specimens in the Museum of Zoölogy. Our indebtedness to the members of the Chicago Herpetologists' Club for their assistance in collecting and companionship in the field, and to Lois Abernathy Stille for preparation of the manuscript, is also acknowledged. Special thanks are due Dr. Howard K. Gloyd for his continual assistance and aid in bringing this paper to press.

LIST OF SPECIES

AMPHIBIA

Caudata

Necturus maculosus maculosus **(Rafinesque)**

Michigan: *Berrien Co.*, Warren's Woods, NU 2570; Harbert, UMMZ 51204.

Triturus viridescens louisianensis **(Wolterstorff)**

Illinois: *DuPage Co.*, Wooddale, CNHM 35761.
Indiana: *LaPorte Co.*, Rolling Praine, CNHM 45315.

Ambystoma jeffersonianum **(Green)**

Indiana: *Jasper Co.*, Grant (1936).
Michigan: *Berrien Co.*, Warren's Woods, RAE 976-8.
Wisconsin: *Racine Co.*, Burlington, CA 11240 (14), RAE 404-5, 406 (2), 522, 602-5, 668.

Ambystoma maculatum **(Shaw)**

Illinois: *DuPage Co.*, Wooddale, CA 6947.

Ambystoma texanum **(Matthes)**

Swanson's report (1939, p. 687) of this salamander from the Jasper-Pulaski Game Preserve is the first record of the form from the Chicago Area.

Ambystoma tigrinum tigrinum **(Green)**

Illinois: *Kane Co.*, Aurora, CNHM 41671.
Michigan: *Berrien Co.*, Three Oaks, UMMZ 52484.
Wisconsin: *Racine Co.*, Burlington, RAE 302-6, 349-86, 449-52, 543, 561-2, 620, WTS 337-8.

Hemidactylium scutatum **(Schlegel)**

Wisconsin: *Walworth Co.*, Elkhorn, NU 2560.

Plethodon glutinosus glutinosus (Green)

Indiana: *Jasper Co.*, Jasper-Pulaski Game Preserve, Swanson (1939).

This seems to be the first authentic record for the slimy salamander in the Chicago Region. It has been previously reported by Hoy (1883) from Racine County, and by subsequent authors on his authority, and on the basis of specimens from Racine in the U. S. National Museum. For reasons outlined previously (Schmidt and Necker, 1935, p. 60, and Edgren, 1944, p. 495) we consider these reports to be erroneous.

Eurycea bislineata bislineata (Green)

Michigan: *Berrien Co.*, Maldonado-Koerdell and Firschein (1947).

Specimens confirming this record would be desirable.

Siren intermedia nettingi Goin

Indiana: *Jasper Co.*, Grant (1936).

Salientia

Bufo terrestris americanus (Holbrook)

Illinois: *Kane Co.*, Batavia, CNHM 44933; West Dundee, RAE 295, WTS 1558-70.

Michigan: *Berrien Co.*, Harbert, UMMZ 51135-41; Riverside, UMMZ 52985; Lakeside, UMMZ 52955-6, Warren's Woods, UMMZ 53243; Sawyer, UMMZ 53244.

Wisconsin: *Racine Co.*, Burlington, RAE 319-22, 506 7, 537-40, 554-5, 563, 570, 575-6, 631.

Bufo woodhousii fowleri Hinckley

Illinois: *Grundy Co.*, Mazon Creek, CNHM 33666.

Acris crepitans Baird

Illinois: *Kane Co.*, West Dundee, WTS 1571-8.

Indiana: *Newton Co.*, Lake Village, WTS 1251. *Starke Co.*, San Pierre, WTS 1295-6. *Jasper Co.*, Jasper-Pulaski Game Preserve, Swanson (1939).

Wisconsin: *Racine Co.*, Burlington, RAE 308-11, 413-25, 512-21, 525, 536, 558-60, 577-617. *Walworth Co.*, Delavan, CA 7461-2.

Pseudacris nigrita triseriata (Wied)

Indiana: *Newton Co.*, Lake Village, WTS 1262-92.

Wisconsin: *Racine Co.*, Burlington, RAE 407-12.

Hyla crucifer crucifer Wied

Illinois: *Cook Co.*, Palos Park, CNHM 33673-5, RAE 114-5, WTS 361-6, 414-5, 601-4, 611-32, 1224-44, 1823-7.

Indiana: *Lake Co.*, Miller, CNHM 31979. *Newton Co.*, Lake Village, WTS 1258-60.

Michigan: *Berrien Co.*, Warren's Woods, NU 2961-5, UMMZ 53299; Harbert, UMMZ 51168-70.

Hyla versicolor versicolor (LeConte)

Illinois: *McHenry Co.*, McHenry, CNHM 30864. *Will Co.*, Custer Park, WTS 1204-5.

Indiana: *Newton Co.*, Lake Village, WTS 1261.

Wisconsin: *Racine Co.*, Burlington, RAE 510, 524, 542, 557, 628, 670-1, 686-8.

Rana catesbeiana Shaw

Indiana: *Starke Co.*, Knox, CNHM 39338 (3).

Michigan: *Berrien Co.*, UMMZ 52061-4; Harbert, UMMZ 51153-5; Sawyer, UMMZ 51219-20.

Rana clamitans Latreille

Illinois: *Kane Co.*, Batavia, CNHM, 44450; West Dundee, RAE 292-4, WTS 1579-86.

Indiana: *Jasper Co.*, Jasper-Pulaski Game Preserve, Swanson (1939).

Wisconsin: *Racine Co.*, Burlington, RAE 312-4, 523-4, 526-7, 556, 573-4, 629, 689.

Rana palustris LeConte

Illinois: *Kane Co.*, Batavia, CNHM 43509.

Michigan: *Berrien Co.*, Warren's Woods, UMMZ 52995-7

Rana pipiens Schreber

Illinois: *Kane Co.*, West Dundee, WTS 1587.

Indiana: *Starke Co.*, San Pierre, WTS 1297. *Jasper Co.*, Jasper-Pulaski Game Preserve, Swanson (1939).

Wisconsin: *Racine Co.*, Burlington, RAE 315-8, 426-48, 508, 571-2, 626-7, 661, 667, 669, 691-3.

REPTILIA

Sauria

Ophisaurus ventralis (Linné)

Illinois: *Grundy Co.*, Pequot, CNHM 33653.

Indiana: *Jasper Co.*, Jasper-Pulaski Game Preserve, Swanson (1939).

Cnemidophorus sexlineatus (Linné)

Illinois: *Grundy Co.*, Pequot, CA 6178-9, 6254-5, CNHM 33652, 33656-8, 33777, 33781.

Indiana: *Jasper Co.*, Jasper-Pulaski Game Preserve, Swanson (1939). *Starke Co.*, Grant (1936).

Eumeces fasciatus (Linné)

Indiana: *Jasper Co.*, Grant (1936). *Porter Co.*, Valparaiso, Grant (1936).

Michigan: *Berrien Co.*, Warren's Woods, UMMZ 54375-6.

Serpentes

Heterodon contortrix **(Linné)**

Indiana: *LaPorte Co.*, Smith, NU 2569. *Jasper Co.*, Jasper-Pulaski Game Preserve, Swanson (1939).

Opheodrys vernalis blanchardi **Grobman**

Indiana: *Lake Co.*, CNHM 2110, Grobman (1941) *LaPorte Co*, Grobman (1941). *Jasper Co.*, Grant (1936).

Coluber constrictor flaviventris **(Say)**

Illinois: *DuPage Co.*, Hinsdale, CNHM 41221. *Grundy Co.*, Mazon Creek, CNHM 33647; Pequot, CNHM 33648. *Will Co.*, Bird's Bridge, CA 6177.

Michigan: *Berrien Co.*, Birchwood Beach, UMMZ 52057; Harbert, UMMZ 51217-8, 52056; Warren's Dunes, UMMZ 54377.

Elaphe obsoleta obsoleta **(Say)**

Michigan: *Berrien Co*, Warren's Woods, RAE 860, UMMZ 53299, 54117-8. (Two additional specimens were alive at Northwestern University as this was written.)

Elaphe vulpina vulpina **(Baird and Girard)**

Illinois: *Kane Co.*, Aurora, CNHM 44998.

Indiana: *Jasper Co*, Jasper-Pulaski Game Preserve, Swanson (1939).

Pituophis catenifer sayi **(Schlegel)**

Illinois: *Grundy Co.*, Dwight, CA 9499. *Will Co.*, Custer Park, RAE 859, CNHM 38240.

Indiana: *Newton Co.*, Enos, NU 2228; Lake Village-Momence, near state line, WTS 1630. *Jasper Co.*, Jasper-Pulaski Game Preserve, Swanson (1939).

Lampropeltis triangulum triangulum **(Lacépède)**

Illinois: *Kankakee Co.*, Rock Creek Park, CNHM 31768.

Indiana: *LaPorte Co.*, Smith, CA 5980. *Jasper Co.*, Jasper-Pulaski Game Preserve, Swanson (1939).

Michigan: *Berrien Co.*, Three Oaks, CA 6637; Harbert, UMMZ 51203.

Swanson (*loc. cit.*, p. 685) indicates his specimens from the Jasper-Pulaski Game Preserve to be intergrades between *triangulum* and *syspila*, but until additional specimens have been collected and the area of intergradation of these forms has been more accurately delineated it seems best to retain all Chicago Area specimens under *triangulum*.

Natrix grahamii **(Baird and Girard)**

Illinois: *Will Co.*, south of Matteson, CNHM 35148.

Natrix kirtlandii **(Kennicott)**

Illinois: *DuPage Co.*, Westmont, CNHM 38063.

Michigan: *Berrien Co.*, Benton Harbor, UMMZ 67264-5.

Natrix septemvittata **(Say)**

Illinois: *Grundy Co.*, Mazon Creek, CA 6193-5; Morris, CNHM 35977. *McHenry Co.*, Island Lake, CNHM 35880-1. *Kendall Co.*, Oswego, CNHM 39235.

Natrix sipedon sipedon (Linné)

Illinois: *Grundy Co.,* Mazon Creek, CA 6191-2, CNHM 33[illegible]19, 33659-60; Morris CNHM 35975-6.

Indiana: *LaPorte Co.,* County Line near New Carlile, WTS 1301-2. *Starke Co.,* San Pierre, WTS 1298-9.

Michigan: *Berrien Co.,* UMMZ 52059; Harbert, UMMZ 51163-5; Warren's Woods, UMMZ 53099.

Storeria dekayi wrightorum Trapido

Illinois: *Kane Co.*, Batavia, CNHM 35006; West Dundee, RAE 296, WTS 1588.

Indiana: *Jasper Co.,* Jasper-Pulaski Game Preserve, Swanson (1939); Jasper-Pulaski Park, Trapido (1944). *Starke Co.,* "northwest corner of county," Trapido (1944).

Wisconsin: *Racine Co.,* Burlington, RAE 300, 327-9, 535, 565; Racine, Trapido (1944). *Walworth Co.,* Elkhorn, NU 2223-4.

Storeria occipitomaculata occipitomaculta (Storer)

Illinois: *DuPage Co.,* Wooddale, CA 6950-3, 6963-5, CNHM 35080, 35317-8, 38125.

Wisconsin: *Racine Co.,* Racine, Trapido (1944).

Thamnophis radix (Baird and Girard)

Illinois: *Kane Co.,* Aurora, CNHM 42068; Elgin, CA 9478, 13035, RAE 290-1.

Wisconsin: *Racine Co.,* Burlington, RAE 387, 566, 680-1, 694.

Thamnophis sauritus proximus (Say)

Indiana: *Jasper Co.,* Jasper-Pulaski Game Preserve, Swanson (1939).

Michigan: *Berrien Co.,* Coloma, CNHM 33569.

Thamnophis sirtalis sirtalis (Linné)

Illinois: *Kane Co.,* Batavia, CNHM 43510.

Indiana: *Newton Co.,* Lake Village, WTS 1319; Mt. Ayr, WTS 1309 *Jasper Co.,* Grant (1936)

Wisconsin: *Kenosha Co.,* Camp Lake, RAF 7; New Munster, CA 6991. *Racine Co.,* Burlington, CNHM 39391, RAE [illegible]30-48, 528, 544, 567-9, 632-60, 678-9, 6[illegible]2-5, 696, WTS 379, 1467-81.

Sistrurus catenatus catenatus (Rafinesque)

Illinois: *DuPage Co.,* Wooddale, CNHM 35314-5. *Will Co.,* Crete, CNHM 42355.

Testudinata

Sternotherus odoratus (Latreille)

Indiana: *LaPorte Co.,* Pine Lake, CNHM 31504. *Newton Co.,* Lake Village, WTS 1254. *Jasper Co.*, Jasper-Pulaski Game Preserve, Swanson (1939).

Wisconsin: *Racine Co.,* Burlington, CNHM 39183, RAE 325-6, 389-403, 509, 622-3, 676, 690, 705-13, 672-5, WTS 380-7.

Kinosternon subrubrum subrubrum (Lacépède)

Indiana: *Newton Co.,* Mt. Ayr, WTS 1310, Stille (1947). *Jasper Co.,* Jasper-Pulaski Game Preserve, Swanson (1939). *Starke Co.,* Grant (1936).

Chelydra serpentina serpentina (Linné)

Illinois: *Grundy Co.,* Coal City, CNHM 37198.

Indiana: *Jasper Co.,* Jasper-Pulaski Game Preserve, Swanson (1939). *Starke Co.,* Grant (1936)

Michigan: *Berrien Co.,* NU 1999; Harbert, UMMZ 51221, S-51247-8; Warren's Dunes, UMMZ 54371.

Wisconsin: *Racine Co.,* Burlington, RAE 324, 624-5, 704, 714-23, 545, 621.

Clemmys guttata (Schneider)

Illinois: *Cook Co.,* Palos Park, RAE 125.

Indiana: *Jasper Co.,* Jasper-Pulaski Game Preserve, Swanson (1939). *Starke Co.,* Grant (1936).

Michigan: *Berrien Co.,* NU 1993; Birchwood, UMMZ 52039; Harbert UMMZ 51224, 51226, 51229-30, S-51233-7, S-51239-43, S-51245-6, 51250, 51252-3.

Emys blandingii (Holbrook)

Illinois: *Kane Co.,* Batavia, CNHM 45819, Dundee Game Farm, CA 13450.

Indiana: *Starke Co.,* Grant (1936).

Michigan: *Berrien Co.,* Harbert, UMMZ 51227, 51232, S-51231; New Buffalo, UMMZ S-46651; Warren's Dunes, UMMZ 54109, 54369.

Wisconsin: *Racine Co.,* Burlington, RAE 323, 697-8; Eagle Lake, NU 1995.

Terrapene carolina carolina (Linné)

Indiana: *Jasper Co.,* Jasper-Pulaski Game Preserve, Swanson (1939).

Michigan: *Berrien Co.,* UMMZ 53003; New Buffalo, UMMZ 46652; Warren's Woods, UMMZ 54372-3.

Terrapene ornata (Agassiz)

Indiana: *Newton Co.* Mt. Ayr, WTS 1308. *Jasper Co.,* Jasper Pulaski Game Preserve, Swanson, (1939). *Starke Co.,* Grant (1936).

Graptemys geographica (LeSueur)

Illinois: *Grundy Co.,* Kankakee River, CA 6660; Diamond, CNHM 35958. *Will Co.,* Kankakee River near county line, CNHM 33651, 33669-70

Michigan: *Berrien Co.,* Ruthven *et al.* (1928).

Chrysemys picta marginata (Agassiz)

Michigan: *Berrien Co.,* Lakeside, NU 1908; Harbert, UMMZ 51222-3, 51225, 51228, 51231, S-51238, S-51244, S-51249; Warren's Woods, UMMZ 54370.

Chrysemys picta marginata x *bellii*

Illinois: *Kane Co.,* Batavia, CNHM 45820; Dundee Game Farm, CA 13442-9.

Indiana: *Newton Co.,* Lake Village, WTS 1255-6. *Starke Co.,* Grant (1936).

Wisconsin: *Racine Co.,* Burlington, RAE 388, 541, 700 3, 724, 531-3, 546-51, WTS 1482-4; Rochester, RAE 530.

Amyda spinifera spinifera (LeSueur)

Illinois: *Grundy Co.,* Morris, NU 1913. *Kane Co.,* Aurora, CNHM 42400. *McHenry Co.,* McHenry, CA 11140.

Indiana: *Jasper Co.,* Jasper-Pulaski Game Preserve, Swanson (1939).

Wisconsin: *Racine Co.,* Burlington, RAE 699; Eagle Lake, RAE 301.

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Vol. 8 No. 8

Chicago Academy of Sciences

Studies in Japanese Pselaphidae (Coleoptera), I. Introductory Materials, Checklist, and Key to Genera.

Orlando Park
Northwestern University

Chicago
Published by the Academy
1948

The Bulletin of the Chicago Academy of Sciences was initiated in 1883 and volumes 1 to 4 were published prior to June, 1913. During the following twenty-year period it was not issued. Volumes 1, 2, and 4 contain technical or semi-technical papers on various subjects in the natural sciences. Volume 3 contains museum reports, descriptions of museum exhibits, and announcements.

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Howard K. Gloyd, Director of the Museum

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Studies in Japanese Pselaphidae (Coleoptera), I. Introductory Materials, Checklist, and Key to Genera.

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CONTENTS

INTRODUCTION

Several years before the onset of the second world war, Mr. LePelley, an official of Kenya Colony, was visiting various entomological laboratories in the United States. I became acquainted with this amiable gentleman while at the University of Illinois and subsequently received two important collections of Japanese pselaphids through his representations, as follows.

The E. Suenson collection covered various localities in northeast Kyushu, the Shimabara Peninsula, Kobé, and an interesting series of Chinese pselaphids from Yenpingfu, in the province of Fukien. This material was gathered during 1934 and 1935.

The J. E. A. Lewis collection, collected between 1927 and 1935, covers a variety of localities in Honshu and Kyushu, but is especially rich in material from the Kobé area.

Both of these collections are admirable in that the data include locality, date, elevation and often other ecological information. In the interval between the arrival of the specimens and the present, these specimens have been mounted or remounted where necessary, labeled, and discriminated in the time that could be given to this interesting task. The results of these studies are to form the subject of several subsequent papers. The present report deals with the faunistic background.

The known pselaphid fauna of Japan at present consists of 83 species, distributed among 27 genera and 8 tribes (Table I). Of the genera, all can be discriminated with the exception of *Morana* (Sharp, 1874, p. 118).

TABLE I

TAXONOMIC DISTRIBUTION OF JAPANESE SPECIES

Tribes	Genera	Endemic Genera	Species
1. Batrisini	7	2	38
2. Brachyglutini	4	1	15
3. Tychini	2	0	8
4. Pselaphini	2	0	4
5. Hybocephalini	1	1	1
6. Ctenistini	5	0	8
7. Tyrini	5	0	7
8. Clavigerini	1	1	2
Totals	27	5	83

Our knowledge concerning this fauna is primarily due to the work of David Sharp, whereas the organization of the genera follows the arrangement given by Raffray (1904, 1908, 1911, 1923-24). Of the 83 species, Sharp described 64, Raffray 15, Weise 3, and one of Sharp's species was preoccupied and renamed by Schaufuss.

The fauna is not well known, and the estimated total of 150 species of Japanese pselaphids given by Sharp in 1883 is probably too conservative. Examination of the table demonstrates two points noted previously by Sharp,

namely the absence of known Euplectini, and the preponderance of Batrisini. On the other hand endemic genera make up 18 per cent of the fauna, and none of the Japanese species are known from other regions as yet.

Quite a few genotypes are represented by Japanese species. These are given in Table II.

TABLE II

GENOTYPES AMONG JAPANESE PSELAPHIDAE

1. *Batristilbus politus* (Sharp), Raffray, 1909, p. 22.
2. *Morana discedens* Sharp, 1874, p. 118.
3. *Triomicrus simplex* Sharp, 1883, p. 326.
4. *Acetalius dubius* Sharp, 1883, p. 322.
5. *Stipesa rudis* Sharp, 1874, p. 109.
6. *Poroderus armatus* (Sharp), 1883, p. 294.
7. *Raphitreus speratus* (Sharp), 1883, p. 298.
8. *Labomimus reitteri* Sharp, 1883, p. 300.
9. *Lasinus spinosus* Sharp, 1874, p. 106.
10. *Diartiger fossulatus* Sharp, 1883, p. 330.

In addition to a dearth of study material, the investigation of the Japanese pselaphids has been retarded by the absence of a local key to the genera. A provisional key is given in the following section, followed by a checklist of the species, and a summary of the localities reported so far in the scanty literature.

PROVISIONAL KEY TO JAPANESE GENERA

The following key is based primarily on the 1908 Raffrayan arrangement and is complete with the exception of *Morana* (Sharp, 1874, p. 118) which can not be integrated with certainty at this time.

1	Antennae of four segments (first hidden from above)	*Diartiger.*
	Antennae of more than four segments	2
2 (1)	Middle legs with femora very obliquely articulated to trochanters so that each femur is near its respective coxa	3
	Middle legs with femora articulated on or near the apex of an elongate, usually subcylindrical, often apically swollen trochanter, so that each femur is distant from its respective coxa	12

3 (2) Pronotum with one or more longitudinal sulci 4
Pronotum without longitudinal sulci (rarely, with a median longitudinal carina for basal half) 8

4 (3) Posterior margin of metasternum truncate between the distant metathoracic coxae *Batrisoplisus.*
Posterior margin of metasternum a narrow acute point or an obtusely triangular process between the subcontiguous metathoracic coxae 5

5 (4) Abdomen with a distinct, well-formed lateral margin on each side of at least the first three visible tergites *Batrisoschema.*
Abdomen either with the lateral "margins" formed by one or two carinae, or with margin wholly absent 6

6 (5) Abdomen wholly immarginate, lacking all traces of marginal carinae *Batristilbus.*
Abdominal "margins" formed by one or two lateral carinae on each side of at least the first visible tergite 7

7 (6) Lateral abdominal "margins" formed by a single longitudinal carina that is short, not as long as the first visible tergite *Batrisocenus.*
Lateral abdominal "margins" formed by two lateral carinae on each side of at least the first visible tergite 24

8 (3) Pronotum with a transverse antebasal sulcus 9
Pronotum without a transverse antebasal sulcus 11

9 (8) Pronotum with a fine median longitudinal carina from basal bead to center of disc *Acetalius.*
Pronotum with no such carina; if a median carina is present it is short, extending from basal bead to the transverse antebasal sulcus 10

10 (9) Each elytron with a long discal stria *Rybaxis.*
No discal elytral striae *Bryaxis.*

11 (8) Third (next-to-last) segment of maxillary palpi subglobular to subtriangular, about as long as wide, with the lateral face more or less simply and evenly convex, and the mesial face more or less strongly angulate *Reichenbachia.*
Third (next-to-last) segment of maxillary palpi distinctly much longer than wide 25

12 (2) Ventral surface of head strongly gibbous or swollen; tarsi with a single claw 13

Ventral surface of head either slightly convex, or flattened, or concave; tarsi with two claws which may be equal or unequal in length 14

13 (12) Maxillary palpi more or less filiform, very long, nearly or quite as long as antennae; with segments I and II of palpi long, united by a simple and nonarticular suture; III small subglobular to subtriangular; IV pedunculate, more or less sinuate basally and swollen apically *Pselaphus.*

Maxillary palpi long and thick; palpal segment I cylindrical; II much longer than wide, regularly thickened apically; III very large, as long as wide to slightly transverse-triangular; IV large, short, subtriangular *Tyraphus.*

14 (12) Pubescence scaly 15

Pubescence of cylindrical, aciculate setae 20

15 (14) Each tarsus with a pair of very unequal claws *Stipesa.*

Each tarsus with a pair of equal or subequal claws 16

16 (15) Pronotal base with three foveae 17

Pronotal base with a single, median, fovea 18

17 (16) Fourth (last) segment of maxillary palpi very transverse-oviform, with rounded apical face, rounded internal (mesial) face, and the external (lateral) face produced as an elongate-acute process bearing an appendage *Pilopius.*

Fourth (last) segment of maxillary palpi very short and oval, weakly acuminate apical face, the segment flattened to concave beneath and convex below with the extremity bearing a tufted appendage *Centrotoma.*

18 (16) Second (may appear as first) segment of maxillary palpi with an appendage or cylindrical brush of setae on lateral (external) face 19

Second (may appear as first) segment of maxillary palpi with no appendage or brush of setae on lateral face *Poroderus.*

19 (18) Ventral surface of head simple *Ctenistes.*

Ventral surface of head with a strong, transverse carina near cervicum, the carina terminating each side beneath an eye in a prominent spinoid tubercle *Sognorus.*

20 (14) Maxillary palpi without appendages on the lateral (external) faces of any segment 23

Maxillary palpi with at least one segment bearing a sharp angulation, or a spine, or a bundle of setae on the lateral face 21

21 (20) Maxillary palpi with segments II and III with their lateral faces angularly dilated and slightly obtusely prolonged *Labominus.*

Maxillary palpi with segments II and III each bearing an acute, elongate spine 22

22 (21) Fourth (last) segment of maxillary palpi much longer than wide, acute-fusiform, and bearing a long spinoid appendage at middle of lateral face *Raphitreus.*

Fourth (last) segment of maxillary palpi not of this shape *Tmesiphorus.*

23 (20) Tergites subequal, with the first visible bearing a median basal tubercle or a median longitudinal carina *Tyrus.*

First visible tergite much larger than second, and with no median tubercle or carina *Lasinus.*

24 (7) Two lateral carinae on each side of at least the first three visible tergites *Batrisodes.*

Two lateral carinae on each side of the first visible tergite only; a single lateral carina may or may not be present on each side of the next two tergites *Batrisus.*

25 (11) Third (next to last) segment of maxillary palpi simply and sharply obconical *Triomicrus.*

Third (next to last) segment of maxillary palpi with the mesial (internal) face angularly dilated *Tychus.*

CHECKLIST OF PSELAPHIDAE KNOWN FROM JAPAN

BATRISINI

Batrisoschema **(Reitter, 1883, p. 399)**

euplectiformis **(Sharp)**

Batrisus euplectiformis Sharp, 1883, p. 303; ? Raffray, 1904, p. 200.
? *Batrisoschema euplectiformis* Raffray, 1908, p. 141.

Type locality: On bluff at Yokohama, May, 1880.

Batrisus **(Aubé, 1833, p. 45)**

pilosus **Sharp (in Waterhouse, 1880, vol. 2, p. 46); Raffray, 1908, p. 157.**

Type locality: Japan.

Batrisodes **(Reitter, 1881, p. 205)**

See also Raffray, 1897, 1908; Reitter, 1909; Park, 1947b, 1948.

acuminatus **(Sharp)**

Batrisus acuminatus Sharp, 1883, p. 307.
Batrisodes acuminatus Raffray, 1904, p. 210; 1908, p. 161; Park, 1948, p. 153.

Type locality: Hakone, in decaying wood; Chiuzenji.

angustus **(Sharp)**

Batrisus angustus Sharp, 1874, p. 113.
Batrisodes angustus Raffray, 1904, p. 210; 1908, p. 161; Park, 1948, p. 153.

Type locality: Japan.

basicornis **(Sharp)**

Batrisus basicornis Sharp, 1883, p. 312.
Batrisodes basicornis Raffray, 1904, p. 210; 1908, p. 161; Park, 1948, p. 153.

Type locality: Miyanoshita.

caviceps **(Sharp)**

Batrisus caviceps Sharp, 1883, p. 308.
Batrisodes caviceps Raffray, 1904, p. 210; 1908, p. 161; Park, 1948, p. 153.

Type locality: Yuyama.

concolor **(Sharp)**

Batrisus concolor Sharp, 1883, p. 310.
Batrisodes concolor Raffray, 1904, p. 210; 1908, p. 161; Park, 1948, p. 153.

Type locality: Yokohama, with black ants.

dionysius **(Schaufuss)**

Batrisus dionysius Schaufuss, Cat. Psel., p. 12. (not seen)
Batrisodes dionysius Raffray, 1904, p. 210; 1908, p. 161; Park, 1948, p. 153.
Batrisus spinicollis Sharp, 1883, p. 304 *teste* Raffray, 1904.

Locality for *spinicollis:* Hitoyoshi, May 7, 1881.

epistomalis Raffray

Batrisodes epistomalis Raffray, 1904, p. 156, fig. 24; 1908, p. 161; Park, 1948, p. 153.

Type locality: Central Japan.

fissifrons (Sharp)

Batrisus fissifrons Sharp, 1883, p. 311.

Batrisodes fissifrons Raffray, 1904, p. 210; 1908, p. 161; Park, 1948, p. 153.

Type locality: Higo.

gracilis (Sharp)

Batrisus gracilis Sharp, 1883, p. 315.

Batrisodes gracilis Raffray, 1908, p. 161; Park, 1948, p. 154.

Type locality: Miyanoshita.

harmandi Raffray

Batrisodes harmandi Raffray, 1904, p. 155, fig. 23; 1908, p. 161; Park, 1948, p. 154.

Type locality: Central Japan.

longicornis (Sharp)

Batrisus longicornis Sharp, 1883, p. 304.

Batrisodes longicornis Raffray, 1904, p. 210; 1908, p. 161; Park, 1948, p. 154.

Type locality: Miyanoshita; Ichiuchi, on the Kumagawa.

nipponensis Raffray

Batrisodes nipponensis Raffray, 1909, p. 23; Park, 1948, p. 154.

Type locality: Kioto.

ornatifrons (Sharp)

Batrisus ornatifrons Sharp, 1883, p. 313.

Batrisodes ornatifrons Raffray, 1904, p. 210; 1908, p. 161; Park, 1948, p. 154.

Type locality: Chiuzenji.

ornatus (Sharp)

Batrisus ornatus Sharp, 1874, p. 114; 1883, p. 312.

Batrisodes ornatus Raffray, 1904, p. 210; 1908, p. 161; Park, 1948, p. 154.

Type locality: Fukuhora; Nagasaki.

Range: Fukuhora, Nagasaki, Nikko, Yanoshiku, and Bukenji near Yokohama.

oscillator (Sharp)

Batrisus oscillator Sharp, 1883, p. 309.

Batrisodes oscillator Raffray, 1904, p. 210; 1908, p. 161; Park, 1948, p. 154.

Type locality: With a species of *Formica* under a stone, on the Mikuni togé.

palpalis (Sharp)

Batrisus palpalis Sharp, 1883, p. 306.

Batrisodes palpalis Raffray, 1904, p. 210; 1908, p. 161; Park, 1948, p. 154.

Type locality: Mayebashi.

punctipennis (Sharp)

Batrisus punctipennis Sharp, 1883, p. 305.

Batrisodes punctipennis Raffray, 1904, p. 210; 1908, p. 161; Park, 1948, p. 154.

Type locality: Miyanoshita and Hakone.

rugicollis (Sharp)

Batrisus rugicollis Sharp, 1883, p. 313.

Batrisodes rugicollis Raffray, 1904, p. 210; 1908, p. 161; Park, 1948, p. 155.

Type locality: Oyama, in Sagami; Miyanoshita.

solitarius (Sharp)

Batrisus solitarius Sharp, 1883, p. 314.

Batrisodes solitarius Raffray, 1904, p. 211; 1908, p. 161; Park, 1948, p. 155.

Type locality: Kiga.

stipes (Sharp)

Batrisus stipes Sharp, 1874, p. 115.

Batrisodes stipes Raffray, 1904, p. 211; 1908, p. 161; Park, 1948, p. 155.

Type locality: Japan.

vestitus (Sharp)

Batrisus vestitus Sharp, 1883, p. 307.

Batrisodes vestitus Raffray, 1904, p. 210; 1908, p. 161; Park, 1948, p. 155.

Type locality: Hakone, in rotted wood; Chiuzenji.

vulgaris Raffray

Batrisodes vulgaris Raffray, 1909, p. 24; Park, 1948, p. 155.

Type locality: Kioto.

Batristilbus (Raffray, 1909, p. 22)

politus (Sharp) Genotype

Batrisus politus Sharp, 1883, p. 310.

Batrisodes politus Raffray, 1904, p. 210; 1908, p. 161; Park, 1948, p. 154.

Batrisus pilosus Waterhouse, 1880, pl. 146, *teste* Raffray, 1904, p. 210.

Batristilbus politus Raffray, 1909, p. 22; Park, 1947a, p. 36.

Type locality: With ants at Chiuzenji; in log mold at Nishimura.

Batrisocenus (Raffray, 1903, p. 48)

dilatatus Raffray, 1909, p. 25.

Type locality: Japan.

dissimilis (Sharp)

Batrisus dissimilis Sharp, 1874, p. 116; 1883, p. 316.

Batrisocenus dissimilis Raffray, 1904, p. 221; 1908, p. 174.

Type locality: Maiyasama, Kobé.

Range: Maiyasama, Kobé and Miyanoshita.

fallax (Sharp)

Batrisus fallax Sharp, 1883, p. 318.

Batrisocenus fallax Raffray, 1904, p. 218; 1908, p. 173.

Type locality: Junsai, on old trees; Miyanoshita, May, 1880; Fukushima, July 28, 1881.

fragilis (Sharp)

Batrisus fragilis Sharp, 1883, p. 317.

Batrisocenus fragilis Raffray, 1904, p. 218; 1908, p. 173.

Type locality: Yokohama, April 7, 1880; Kioto, July 2, 1881; Niigata, September 6 and 13.

japonicus (Sharp)

Batrisus japonicus Sharp, 1883, p. 318.

Batrisocenus japonicus Raffray, 1904, p. 218; 1908, p. 173.

Type locality: Hakone; Miyanoshita; Nagasaki.

modestus (Sharp)

Batrisus modestus Sharp, 1874, p. 116; 1883, p. 320.

Batrisocenus modestus Raffray, 1904, p. 219; 1908, p. 173.

Type locality: Nagasaki.

Range: Nagasaki and Miyanoshita.

optatus (Sharp)

Batrisus optatus Sharp, 1874, p. 112.

Batrisocenus optatus Raffray, 1904, p. 218; 1908, p. 173.

Type locality: Nagasaki.

pedator (Sharp)

Batrisus pedator Sharp, 1883, p. 306.

Batrisocenus pedator Raffray, 1904, p. 220; 1908, p. 173.

Type locality: Niigata, September 15, 1881.

puncticollis (Sharp)

Batrisus puncticollis Sharp, 1883, p. 316.

Batrisocenus puncticollis Raffray, 1904, p. 221; 1908, p. 174.

Type locality: Kashiwagi, June 18, 1881.

semipunctatus Raffray

Batrisocenus semipunctatus Raffray, 1909, p. 25.

Type locality: Japan.

similis **(Sharp)**

Batrisus similis Sharp, 1883, p. 319.
Batrisus sharpi Schaufuss, 1883, p. cxvi, *teste* Raffray, 1904, p. 218.
Batrisocenus similis Raffray, 1904, p. 218; 1908, p. 173.

Type locality: Yokohama; Oyama, May 28, 1880.

Batrisoplisus **(Raffray, 1908, p. 180)**

antennatus **(Weise) Genotype**

Batrisus antennatus Weise, 1877, p. 97; Sharp, 1883, p. 320.
Batrisocenus antennatus Raffray, 1904, p. 219.
Batrisoplisus antennatus Raffray, 1908, p. 181.

Type locality: Oschirojama.

Range: Oschirojama, (? Hoshiroyama); Nagasaki; Fukuhora; Sanjo; Niigata.

Morana **(Sharp, 1874, p. 118)**

discedens **Sharp Genotype**

M. discedens Sharp, 1874, p. 118; 1883, p. 321; Raffray, 1904, p. 226 (Batrisini ?).

Type locality: Nagasaki.

BRACHYGLUTINI

Reichenbachia **(Leach, 1826, p. 451)**

aliena **(Sharp)**

Bryaxis alienus Sharp, 1874, p. 120; 1883, p. 323.
Reichenbachia aliena Raffray, 1904, p. 362 (Group 49); 1908, p. 240.

Type locality: Hiogo and Nagasaki.

antilope **Raffray**

R. antilope Raffray, 1909, p. 30.

Type locality: Kioto.

crassipes **(Sharp)**

Bryaxis crassipes Sharp, 1874, p. 125.
Reichenbachia crassipes Raffray, 1904, p. 358 (Group 30); 1908, p. 239.

Type locality: Nagasaki.

cubitus **(Sharp)**

Bryaxis cubitus Sharp, 1874, p. 122; 1883, p. 323.
Reichenbachia cubitus Raffray, 1904, p. 362 (Group 49); 1908; p. 240.

Type locality: Nagasaki.

curta **(Sharp)**

Bryaxis curtus Sharp, 1874, p. 124.
Reichenbachia curta Raffray, 1904, p. 353 (Group 7); 1908, p. 237.

Type locality: Nagasaki.

diffinis (Sharp)

Bryaxis diffinis Sharp, 1883, p. 324.

Reichenbachia diffinis Raffray, 1904, p. 359 (Group 35); 1908, p. 239.

Type locality: Yokohama.

? latifrons (Sharp)

Bryaxis latifrons Sharp, 1883, p. 325.

? Reichenbachia latifrons Raffray, 1904, p. 364; 1908, p. 241.

Type locality: Miyanoshita.

munda (Sharp)

Bryaxis mundus Sharp, 1874, p. 122.

Reichenbachia munda Raffray, 1904, p. 352 (Group 6); 1908, p. 237.

Type locality: On Mitzuyama, Nagasaki.

pulla (Sharp)

Bryaxis pullus Sharp, 1874, p. 132.

Reichenbachia pulla Raffray, 1904, p. 354 (Group 12); 1908, p. 238.

Type locality: On Mitzuyama, at 1,500 feet elevation, near Nagasaki.

Rybaxis (Saulcy, 1876, p. 96)

princeps (Sharp)

Bryaxis princeps Sharp, 1874, p. 118; 1883, p. 323.

Rybaxis princeps Raffray, 1904, p. 368 (Group 6); 1908, p. 248.

Type locality: Nagasaki.

infuscata Raffray

R. infuscata Raffray, 1909, p. 33.

Type locality: Kioto.

Triomicrus (Sharp, 1883, p. 325)

protervus (Sharp)

Bryaxis protervus Sharp, 1874, p. 121.

Triomicrus protervus Raffray, 1904, p. 338; 1908, p. 253.

Type locality: Kobé.

simplex Sharp Genotype

T. simplex Sharp, 1883, p. 326; Raffray, 1904, p. 338; 1908, p. 253.

Type locality: Niigata.

sublaevis Raffray

T. sublaevis Raffray, 1909, p. 31.

Type locality: Kioto; Tokyo.

Acetalius (Sharp, 1883, p. 322)

dubius Sharp Genotype

A. dubius Sharp, 1883, p. 322; Raffray, 1904, p. 375; 1908, p. 256.

Type locality: Suwa Temple, among dead leaves, April 8, 1881.

TYCHINI

Bryaxis (Kugelann, 1794, p. 580)

affinis (Sharp)

Bythinus affinis Sharp, 1883, p. 326.

Bryaxis affinis Raffray, 1904, p. 398 (Group 9); 1908, p. 276.

Type locality: Nagasaki.

harmandi Raffray

B. harmandi Raffray, 1909, p. 38.

Type locality: Tokyo.

japonica japonica (Sharp)

Bythinus japonicus Sharp, 1874, p. 125; 1883, p. 327.

Bryaxis japonica Raffray, 1904, p. 408 (Group 47); 1908, p. 279; 1909, p. 37.

Type locality: Fukuhora; Nagasaki.

Range: Fukuhora; Nagasaki; Miyanoshita; Hoshiroyama; Kioto.

japonica humilis Raffray

B. japonica humilis Raffray, 1909, p. 37.

Type locality: Nagasaki; Kioto.

reversa (Sharp)

Bythinus reversus Sharp, 1883, p. 327.

Bryaxis reversa Raffray, 1904, p. 397 (Group 6); 1908, p. 276.

Type locality: Nagasaki.

sauteri Raffray

B. sauteri Raffray, 1909, p. 39.

Type locality: Yamanaka.

subseriata (Weise)

Bythinus subseriatus Weise, 1877, p. 98; Sharp. 1883, p. 327.

Bryaxis subseriata Raffray, 1904, p. 408 (Group 47); 1908, p. 279.

Type locality: Oschirojama, Hagi (Weise and Sharp) or Hoshiroyama (Raffray).

Tychus (Leach, 1817, p. 84)

crassicornis Raffray

T. crassicornis Raffray, 1909, p. 40.

Type locality: Kioto?

PSELAPHINI

Pselaphus (Herbst, 1792, p. 106)

debilis Sharp

P. debilis Sharp, 1883, p. 328; Raffray, 1904, p. 451; 1908, p. 307

Type locality: Near Suwa Temple.

japonicus Raffray

P. japonicus Raffray, 1909, p. 42.

Type locality: Kioto.

lewisi Sharp

P. lewisii Sharp, 1883, p. 329.

P. Lewisi Raffray, 1904, p. 446; 1908, p. 306.

Type locality: Nagasaki, May 28, 1881.

Tyraphus (Sharp, 1874, p. 489)

nitidus Raffray, 1908, p. 313; 1909, p. 43.

Type locality: Japan (1908); Kioto (1909).

HYBOCEPHALINI

Stipesa (Sharp, 1874, p. 109)

rudis Sharp Genotype

S. rudis Sharp, 1874, p. 109; Raffray, 1904, p. 437; 1908, p. 326.

Type locality: Suwo-sama, Nagasaki.

CTENISTINI

Centrotoma (Heyden, 1849, p. 182)

prodiga Sharp

C. prodiga Sharp, 1874, p. 107; 1883, p. 296; Raffray, 1904, p. 472; 1908, p. 335.

Type locality: Nagasaki.

Range: Nagasaki; also with a "claviger ant," on the Shiwojiri-toge, July 30, 1881.

Pilopius (Casey, 1897, p. 617)

discedens (Sharp)

Ctenistes discedens Sharp, 1883, p. 296.

? *Sognorus discedens* Raffray, 1904, p. 477.

Pilopius discedens Raffray, 1908, p. 337.

P. discedens Park, 1942, p. 293.

Type locality: Hitoyoshi, May 8, 1881; Kioto, June 10, 1881.

Ctenistes (Reichenbach, 1816, p. 75)

mimeticus Sharp

C. mimeticus Sharp, 1883, p. 295; Raffray, 1904, p. 474; 1908, p. 338.

Type locality: Nagasaki, April 12, 1881.

oculatus Sharp

C. oculatus Sharp, 1874, p. 110.

C. oculatus Raffray, 1904, p. 474 (Group 4).

Type locality: Japan.

Sognorus (Reitter, 1881, p. 202)

breviceps (Sharp)

Ctenistes breviceps Sharp, 1883, p. 296.

? *Ctenistes breviceps* Raffray, 1904, p. 477.

? *Sognorus breviceps* Raffray, 1908, p. 341.

Type locality: Tokyo (Tokio), March 25, 1880; Yokohama and Niigata, September 13, 1881.

Poroderus (Sharp, 1883, p. 294)

armatus (Sharp) Genotype

Ctenistes armatus Sharp, 1874, p. 111.

Poroderus armatus Sharp, 1883, p. 294; Raffray, 1904, p. 481; 1908, p. 341; pl. 9, fig. 33.

Type locality: Nagasaki.

medius (Sharp)

Ctenistes medius Sharp, 1874, p. 111.

Poroderus medius Sharp, 1883, p. 294; Raffray, 1904, p. 481; 1908, p. 342.

Type locality: Fukuhora; Nagasaki.

similis (Sharp)

Ctenistes similis Sharp, 1874, p. 112.

Poroderus similis Sharp, 1883, p. 294; Raffray, 1904, p. 482; 1908, p. 342.

Type locality: Nagasaki.

TYRINI

Tmesiphorus (LeConte, 1850, p. 75)

costatus Weise

T. costatus Weise, 1877, p. 99; Sharp, 1883, p. 300; Raffray, 1904, p. 544 (Group 2); 1908, p. 374.

Type locality: Hoshiroyama (Oschirojama) near Hagi.

crassicornis Sharp

T. crassicornis Sharp, 1883, p. 209; Raffray, 1904, p. 545 (? Group 8); 1908, p. 374.

Type locality: Suwa Temple, with black ants, in Nagasaki on July 31, 1871; Shiba, with black ants, in Tokyo on May 21, 1880; Nanaye, S. Yezo.

princeps Sharp

T. princeps Sharp, 1883, p. 209; Raffray, 1904, p. 545 (? Group 8); 1908, p. 374.

Type locality: Futai, with black ants, on September 20, 1881.

Raphitreus **(Sharp, 1883, p. 298)**

speratus **(Sharp) Genotype**

Tmesiphorus speratus Sharp, 1874, p. 109; Raffray, 1904, p. 544.

Raphitreus speratus Sharp, 1883, p. 298; Raffray, 1904, p. 545; 1908, p. 376.

Type locality: Maiyasama, Hiogo.

Range: Maiyasama, Hiogo; Maiyasan, Kobé, July 14, 1881; Kashiwagi, June 23, 1881; Oyama, May 25, 1880.

Labomimus **(Sharp, 1883, p. 300)**

reitteri **Sharp Genotype**

L. reitteri Sharp, 1883, p. 300; Raffray, 1904, p. 546.

L. Reitteri Raffray, 1908, p. 376-377.

Type locality: Hakonê.

Lasinus **(Sharp, 1874, p. 106)**

spinosus **Sharp Genotype**

L. spinosus Sharp, 1874, p. 106; 1883, p. 301; Raffray, 1904, p. 546; 1908, p. 378.

Type locality: In decayed leaves in the woods of Suwo-sama, Nagasaki.

Range: Nagasaki; Kuroheiji, Miyanoshita, Kiga, Kioto, Kobè, Osaka, and Oyama in Sagami.

Tyrus **(Aubé, 1833, p. 15)**

japonicus **Sharp**

T. japonicus Sharp, 1883, p. 302; Raffray, 1904, p. 547; 1908, p. 379.

Type locality: Nagasaki; Hitoyoshi; Kobé; Wada togé.

CLAVIGERINI

Diartiger **(Sharp, 1883, p. 329)**

fossulatus **Sharp Genotype**

D. fossulatus Sharp, 1883, p. 330; Raffray, 1904, p. 585; 1908, p. 438, pl. 2, fig.20.

Type locality: Hakonê and Miyanoshita with a species of ? *Formica*, May, 1880; Shimabara and Fukuhori, near Nagasaki; Futai with the same ant; Hitoyoshi.

spinipes **Sharp**

D. spinipes Sharp, 1883, p. 331; Raffray, 1904, p. 585; 1908, p. 438.

Type locality: Yuyama, May 10, 1881.

COLLECTING LOCALITIES IN THE LITERATURE

Bukenji (HONSHU)
Chiuzenji
Fukuhora (KYUSHU)
Fukushima (HONSHU)
Futai
Hagi (HONSHU)
Hakonê ”
Higo
Hiogo (? Hioge, HONSHU)
Hitoyoshi (KYUSHU)
HONDO (var. HONSHU)
Hoshiroyama ”
Ichiuchi (on the Kumagawa)
Junsai
Kashiwagi
Kiga
Kioto (var. Kyoto)
KIUSHU (var. KYUSHU)
Kobé (HONSHU)
Kumagawa (? Kumagaya, HONSHU)
Kuroheiji
Kyoto (HONSHU)
Maiyasama
Maiyasan
Mayebashi (HONSHU)
Mikuni togé ”
Mitzuyama
Myanoshita
Nagasaki (KYUSHU)
Nanaye (HOKKAIDO)
Niigata (HONSHU)
Nikko ”
Nishimura
Oschirojama (var. Hoshiroyama)
Osaka (HONSHU)
Oyama ”
Sagami
Sanjo (HONSHU)
Shiba (Tokyo area)
Shimabara peninsula (KYUSHU)
Shiwojiri-toge
Suwa Temple (Nagasaki area)
Suwo-sama (Nagasaki area)
Tokio (var. Tokyo)
Tokyo (HONSHU)
Wada toge
Yamanaka
Yanoshiku
YESSO (var. YEZO)
YEZO (var. HOKKAIDO)
Yokohama (HONSHU)
Yuyama

SUMMARY

In a provisional report, the relatively poorly known pselaphid fauna of Japan is found to have 83 species reported from the literature, distributed among 27 genera and 8 tribes. Taxonomic distribution is given in tabular form, and genotypes listed. A key to genera is provided. The fauna is organized in a checklist that includes synonymy, citations to the literature, type localities, and geographic range where such data are available. The collecting localities reported previously are listed, and variations of spelling are noted.

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Vol. 8 No. 9

Bulletin of the Chicago Academy of Sciences

The Subspecies of the Massasauga, *Sistrurus catenatus*, in Missouri

Philip D. Evans and Howard K. Gloyd

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1948

The Bulletin of the Chicago Academy of Sciences was initiated in 1883 and volumes 1 to 4 were published prior to June, 1913. During the following twenty-year period it was not issued. Volumes 1, 2, and 4 contain technical or semi-technical papers on various subjects in the natural sciences. Volume 3 contains museum reports, descriptions of museum exhibits, and announcements.

Publication of the *Bulletin* was resumed in 1934 with volume 5 in the present format. It is now regarded as an outlet for short to moderate-sized original papers on natural history, in its broad sense, by members of the museum staff, members of the Academy, and for papers by other authors which are based in considerable part upon the collections of the Academy. It is edited by the Director of the Museum with the assistance of a committee from the Board of Scientific Governors. The separate numbers are issued at irregular intervals and distributed to libraries and scientific organizations, and to specialists with whom the Academy maintains exchanges. A reserve is set aside for future need as exchanges and the remainder of the edition offered for sale at a nominal price. When a sufficient number of pages have been printed to form a volume of convenient size, a title page, table of contents, and index are supplied to libraries and institutions which receive the entire series.

Howard K. Gloyd, Director of the Museum

Committee on Publications:

Alfred Emerson, Professor of Zoology, University of Chicago.
C. L. Turner, Professor of Zoology, Northwestern University.
Hanford Tiffany, Professor of Botany, Northwestern University.

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Bulletin of the Chicago Academy of Sciences

The Subspecies of the Massasauga, *Sistrurus catenatus*, in Missouri

Philip D. Evans and Howard K. Gloyd*

Since the publication of a monographic study of the rattlesnakes (Gloyd, 1940) a considerable number of additional specimens of the massasauga, *Sistrurus catenatus*, has become available from Missouri. A study of this new material, a total of 67 specimens, has revealed that earlier conclusions as to the region of intergradation between the two subspecies, *tergeminus* and *catenatus*, must be modified. It has also been found that the localities recorded for certain specimens in museums, and some of the distributional records of these rattlesnakes in Missouri, are erroneous or highly questionable. Accordingly, we present here the results of an examination of this new material and a critique of some previously published records.

We are grateful to Kenneth Krumm of Sumner and Paul Anderson of Independence, Missouri, for assistance in obtaining specimens and to Dr. W. T. Garrett of Northwest Missouri State Teachers College, Maryville, for the loan of specimens for study.

As pointed out by Gloyd *(op. cit.*, p. 21, 39, 47), the chief diagnostic differences between the subspecies *tergeminus* and *catenatus* are: (1) the number of ventrals; (2) the number of dorsal blotches; and (3) general coloration, particularly the degree of mottling or blotching of the ventral surface. Another character has been found useful in this study; viz., the dorsal pattern of the head. In *tergeminus* this design is typically an ornate, lyriform figure, symmetrical in most specimens, and usually with the two lateral portions not connected with each other across the posterior frontal and supraocular region (Plate I, Figure 1). In *catenatus* the figure is less symmetrical, the lateral

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portions are more slender, with margins less frequently incised, and the anterior ends usually united across the posterior frontal region and supraoculars (Plate I, Figure 3). In addition to these there are more subtle differences in pattern and coloration, difficult to describe but quite obvious to anyone in the course of increasing familiarity with fairly large series of specimens.

On the basis of the characters enumerated above, it is apparent that the specimens from the extreme western part of the state (Andrew, Holt, Jackson, and Platte Counties) represent the western subspecies, *tergeminus;* those from eastern Missouri (St. Charles County) are typical of the eastern subspecies, *catenatus;* and those from north-central Missouri (Chariton and Saline Counties) are intermediate. The material studied has accordingly been classified as follows:*

Sistrurus catenatus tergeminus (Say)

Andrew Co.—2 miles west of Fillmore, CA 10843.

Holt Co.—5 miles south of Mound City, CA 8612, 8657-63, 8691, 8878-80, 8888, and two specimens loaned by Dr. W. T. Garrett.

Jackson Co.—Swope Park, Kansas City, KU 2317.

Platte Co.—Bean Lake, CA 10756, 10844; East Leavenworth, CA 10757.

Intergrades between *S. c. tergeminus* and *S. c. catenatus*

Chariton Co.—4 miles southeast of Sumner, CA 8197-200, 8611; 5 miles southeast of Sumner, CA 8645-7, 8649-54, 8656; 5 miles south of Sumner, CA 8819, 8886-7.

Saline Co.—Missouri River bottoms, near Miami, CA 11182.

Sistrurus catenatus catenatus (Rafinesque)

St. Charles Co.—Dardenne Prairie, USNM 56246 (Collected by Julius Hurter); CA 8182, 8184; Dardenne Lake, CA 8183, 8185-6, 8189-96, USDA, Biol. Surv. H 4841; Silver Lake, CA 8187-8, 8583-93.

VARIATION IN INTERGRADING CHARACTERS

Characters such as number of scale rows, subcaudals, labials, and tail/total-length ratio in the Missouri specimens do not vary significantly from the summaries given by Gloyd (*ibid.,* p. 34). Therefore consideration here will be given only to those characters in which geographic variation and evidence of intergradation are found.

Variation in number of ventrals in the three series under scrutiny is summarized in Table I. It will be noted that the intermediates from Chariton County more closely approach the western series than the eastern in number

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*Museum abbreviations: CA - Chicago Academy of Sciences; KU - University of Kansas, Museum of Natural History; USNM - U. S. National Museum; USDA, Biol. Surv. - Collection of the Fish and Wildlife Service, U. S. Department of the Interior.

of ventrals of both sexes, but that the eastern series from St. Charles County average fewer, in line with the general tendency toward reduction in number from west to east (Gloyd, *ibid.*, p. 34, 43, 55).

Table I. Variation in Ventrals

	Males			Females		
	No.	Extremes	Average	No.	Extremes	Average
S. c. tergeminus	9	142-149	145.6	11	146-155	150.4
Intergrades	9	141-149	144.4	10	146-154	150.4
S. c. catenatus	17	136-146	140-4	11	142-149	145.4

Variation in number of dorsal blotches shows a similar pattern (Table II): the intermediates are closer to the western specimens, especially in the males, but again there is a reduction in number from west to east as previously noted (Gloyd, *ibid.,* p. 34, 43, 55).

Table II. Variation in Dorsal Blotches on Body

	Males			Females		
	No.	Extremes	Average	No.	Extremes	Average
S. c. tergeminus	9	34-42	37.6	11	37-50	42.3
Intergrades	9	35-42	37.8	10	33-42	39.4
S. c. catenatus	17	29-37	32.3	11	32-39	35.0

In general, considering the entire species population of *S. catenatus,* eastern specimens are darker in coloration and western ones are lighter. This is especially striking when individuals from the geographic extremes of the range are compared. Missouri lies almost in the center of the range, however, and although neither extreme in coloration is evident in examples from this state, the western specimens are conspicuously lighter in color, both above and below, than the intermediates and those of the eastern series. The belly is generally dark (nearly all black or heavily mottled) in those of the eastern series and the intermediates, while in those from the west the light ground color of the belly is less obscured and the dark blotches are more distinct. Ventral coloration apparently varies with age, for in all the young these markings are more distinct, or less diffused, than in adults.

The dorsal pattern of the head, to which reference was made above, is illustrated in Plate I, Figures 1-3. In western specimens the lyre-shaped figure stands out conspicuously, the two longitudinal lateral bars diverging anteriorly on the posterior portions of the supraoculars. In eastern specimens these bars are more nearly parallel and tend to converge and coalesce on the posterior part of the frontal and supraoculars. In the majority of specimens from Chariton and Saline Counties the form of this pattern is intermediate.

ERRONEOUS LOCALITY RECORDS

Among the Missouri localities listed by Gloyd (1940, p. 51) as represented by specimens examined are two that are probably in error: Madison and St. Louis Counties.

Two specimens bearing the data of Madison County, Missouri are numbers 15262-3 in the collection of the American Museum of Natural History. Both specimens were collected by J. W. Mackeldon, August 4-18, 1896. Madison County, Missouri is about 100 miles farther south than the species is known to occur in the eastern part of the state, and suitable habitats are completely lacking in that locality. The entire county is typical of the Ozark Region in which it is located. It is a rocky, hilly area covered with scrub oak and other timber, except where cleared for agriculture and stock grazing. The soil throughout most of the county is Ashe and Clarksville stony loam (Miller and Krusekopf, 1929). This is in sharp contrast with Madison County, Illinois, with its low flat prairies where massasaugas were known to be abundant years ago and are still present in limited numbers, despite the inroads made on their habitat by agriculture. It was in the West Prairie of Madison County, Illinois that Hurter collected 59 of these snakes in two hours in 1890 (Hurter, 1911, p. 210). In 1926, Mr. Mackeldon told one of us (Evans) that he did not know of any of these snakes having been found in Missouri except north of the Missouri River. He also referred to the fact that both he and Julius Hurter had collected numbers of them in the Dardenne Prairie in St. Charles County, Missouri, and in the West Prairie of Madison County, Illinois. Another pertinent consideration is that Hurter (1911) did not include Madison County in his list of Missouri localities. In spite of the fact that Hurter did not mention Mackeldon in his long list of acknowledgments, they are known to have been close friends. Since they collected together a great deal, Mackeldon's material must have been available to Hurter. It is highly probable, therefore, that these two Mackeldon specimens in the American Museum were collected in Madison County, Illinois.

St. Louis County, Missouri is given as the locality of two specimens: Museum of Comparative Zoology 6406 and Chicago Academy of Sciences 132. This locality is questionable, although not entirely illogical. Parts of St. Louis County along the Missouri River in the vicinity of St. Charles appear to have suitable habitats for the species, although none of the collectors known to us who live or have lived in St. Louis have ever found massasaugas in the county.

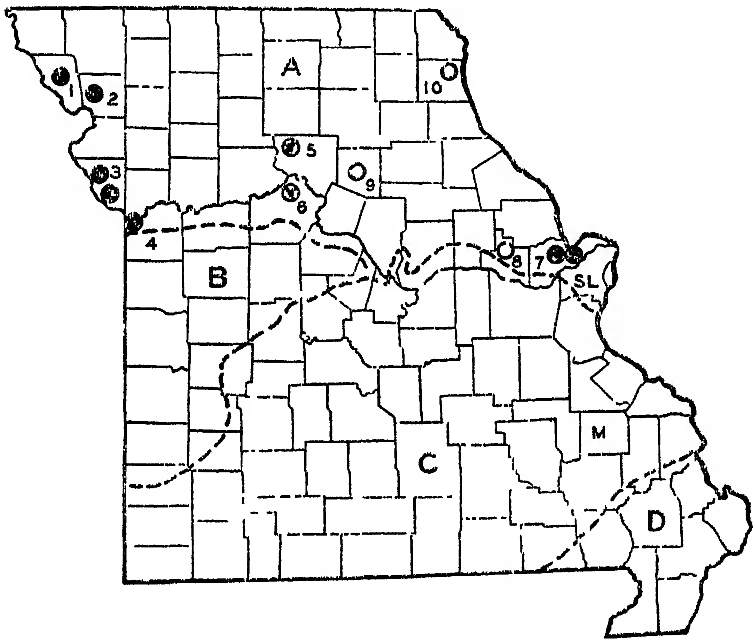

Figure 1. Distribution of *Sistrurus catenatus* in Missouri.

Solid spots indicate *tergeminus* in the west, *catenatus* in the east; crosses within circles, intergrades: open circles, localities reported by Hurter (1911, p. 209).

Numbers indicate counties as follows: 1 Holt, 2 Andrew, 3 Platte, 4 Jackson, 5 Chariton, 6 Saline, 7 St. Charles, 8 Warren, 9 Randolph, 10 Lewis. M indicates Madison County and S L, St. Louis County.

A—North Missouri Glacial and Loessal Region, B—Southwest Missouri Prairie, C—Ozark Region, D—Southeast Missouri Lowland. After Miller and Krusekopf, 1929, p. 9.

The specimen in the Museum of Comparative Zoölogy (6406) was collected by Hurter in 1892 and the locality given as St. Louis, Missouri. It is possible that this specimen was entered in the catalog as from St. Louis

because Hurter lived there. In his paper *Catalogue of Reptiles and Batrachians Found in the Vicinity of St. Louis, Mo.* (1893, p. 258) Hurter wrote, with reference to this species: "So far I have found this snake only on what is known as the 'Wet Prairie,' near Edwardsville, Madison County, Ills." It is not known when Hurter wrote this paper, but it could not have been before 1892 for he refers to Garman's *Synopsis of the Amphibians and Reptiles of Illinois* which was published in that year. This locality is also missing from his list of Missouri localities published in 1911, and in this paper he makes a similar statement (p. 209): "So far I have only found the Massasauga at West Prairie, Madison Co., Ill., and at Dardenne Prairie, St. Charles Co., Mo." It is therefore probable that this specimen (MCZ 6406) is one of the snakes from the West ("Wet") Prairie in Madison County, Illinois.

The specimen in the Chicago Academy of Sciences (132) was among the miscellaneous lot of alcoholic reptiles received from Northwestern University in 1931 and has been assumed to have been collected by Robert Kennicott. In an earlier catalog of the Academy it was entered in ink as "Illinois" and over this entry "St. Louis, Mo." has been written in pencil. The space for indicating the collector is blank. Later it was entered in the permanent catalog as "St. Louis, Mo." The reason for the penciled over-script is unknown to us. It now seems advisable to consider this specimen as having no data and to regard the St. Louis locality for this species as highly questionable.

ECOLOGICAL AND PHYSIOGRAPHICAL CONSIDERATIONS

From knowledge of the habitats of the massasauga in other regions as well as in Missouri, it is clear that the species is a lowland form, typical of prairie and plains in the west and of marshy areas and swampy woodlands in the east. It is not surprising therefore that the species is absent from the Ozark Region and apparently confined to the North Missouri Glacial and Loessal Region as defined by Miller and Krusekopf (Fig. 1, A). This region is the southern limit of the glaciated prairie embracing a large part of north-central United States. It is in general a rolling prairie, but level in places, particularly in and near the river bottoms. The elevation in the northwest corner of the state is approximately 1200 feet above sea level, sloping to the east and south to an elevation of 600 feet in the low prairie areas of St. Charles County. Much of the region is covered with loessal deposits. A chain of loess hills runs from Jackson County northward along the Missouri River, forming huge mounds in Holt and Atchison Counties.

The region is traversed by several timber belts, particularly in the east and central portions. It is drained by the Missouri River to the west and south and by the Mississippi River to the east. In the east numerous small

streams flow in a southeasterly direction into the Mississippi River. Southward through the west-central section flow two major tributaries of the Missouri River, the Grand and the Chariton Rivers. These streams are not large but have wide flood basins surrounded by level prairies in Livingston, Linn, Chariton, and Carroll Counties. Numerous sloughs and marshes that have been formed here are thickly populated with reptile life. Similar situations are found in Holt County in the flood basin of the Missouri and Tarkio Rivers and in St. Charles County in the flood basin of the Mississippi.

In addition to the massasauga, two other species of snakes occur in Missouri only in this region: the fox snake *(Elaphe vulpina)* and the plains garter snake *(Thamnophis radix)*. The former, like the eastern massasauga, is a species typical of the glaciated prairie region of north-central United States; it occurs in the eastern part of the North Missouri Glacial Region from St. Charles County north. The latter ranges through the major part of the Great Plains, from the Rocky Mountains eastward to Michigan and Ohio, and apparently occurs throughout most of northern Missouri.

The apparent absence of the massasauga from the Southwest Missouri Prairie (Fig. 1, B) is probably due to insufficient collecting in this area. Farmers in southern Pettis County and northwestern Benton County are reported to have killed small "prairie rattlers" occasionally and eventually specimens may be obtained. This unglaciated region is an eastward extension of the Great Plains, a grassland-deciduous forest transition, and in general is flat, open prairie with gently rolling topography in some areas. It lies in the shape of an irregular triangle wedged between the Ozark Region to the southeast and the North Missouri Glacial region to the north. Most of it has an elevation of approximately 900 to 1000 feet, but it reaches about 1150 feet in Cass County and in the southern part of Jackson County. The massasauga is known to occur in similar territory in eastern Kansas and specimens from this area, only a short distance to the west, are regarded as intergrades (Gloyd, 1940, p. 41, 49). It may logically be expected, therefore, that specimens from the Southwest Missouri Prairie would be intergrades between *tergeminus* and *catenatus.*

SUMMARY

Two subspecies of the massasauga occur in Missouri, *Sistrurus catenatus tergeminus* in the west and *Sistrurus catenatus catenatus* in the east, with an intergrading population known from an intermediate area (Chariton and Saline Counties).

The previously published records for the massasauga in Madison County, Missouri are shown to be probably based on specimens from Madison Coun-

ty Illinois, and the records for St Louis County, Missouri are questioned

The massasauga is apparently limited in Missouri to the North Missouri Glacial and Loessal Region, most of which lies north of the Missouri River, and which is similar to the territory occupied by the species in other parts of its range

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1

2

3

Figure 1 *S. c. tergeminus* CA 8879 5 miles south of Mound City Holt County
Figure 2 Intergrade *tergeminus* x *catenatus* CA 8666 5 miles southeast of Sumner Chariton County
Figure 3 *S. c. catenatus* CA 8168 Silver Lake St Charles County

Figure 4 Intergrade *tergeminus* x *catenatus* CA 8611 4 miles southeast of Sumner Chariton County Photographs by H K Gloyd

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etin

Chicago Academy of Sciences

Geographic Variation in Marcy's Garter Snake, *Thamnophis marcianus* (Baird and Girard)

M. B. Mittleman

Chicago
Published by the Academy
1949

The Bulletin of the Chicago Academy of Sciences was initiated in 1883 and volumes 1 to 4 were published prior to June, 1913. During the following twenty-year period it was not issued. Volumes 1, 2, and 4 contain technical or semi-technical papers on various subjects in the natural sciences. Volume 3 contains museum reports, descriptions of museum exhibits, and announcements.

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Howard K. Gloyd, Director of the Museum

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Bulletin of the Chicago Academy of Sciences

Geographic Variation in Marcy's Garter Snake, *Thamnophis marcianus* (Baird and Girard)

M. B. Mittleman*

Although described nearly 100 years ago, *Thamnophis marcianus* has never been subjected to a detailed zoogeographic study. Ruthven, in discussing this species (1908), noted its apparent homogeneity, and later writers such as Van Denburgh (1922) and Smith (1942) have contributed to the general fund of knowledge concerning the distribution and natural history of this snake but have actually shed little light on its variability. Recent years have seen the accumulation of a considerable number of specimens, and with this new material it is now possible to approximate the true geographic variability of *marcianus.*

STRUCTURAL VARIATION

Dorsal Scales. The dorsal scales in the type, and in slightly more than 94 per cent of 219 specimens, are in 21 rows from the neck to the anterior part of the last third of the body, at which point a pair of rows is dropped, producing a count of 19, and shortly thereafter (slightly anterior to the vent) another pair is dropped, resulting in a final count of 17; thus, the normal dorsal scale row formula for this species is 21-21-19-17. In a few specimens, certain abnormalities have been noted; for the most part, these result from the aberrant addition or deletion of a pair of scale rows, but in a few instances scale rows have been kept which are normally dropped.

A relatively common aberration occurs through the intercalation of an additional scale row on each side of the body; this usually occurs at about the middle of the anterior third of the body, and after continuing for a short distance the anomalous rows are dropped. In some specimens the interposed rows may extend for only about 10 ventrals before they disappear, resulting

*35 John Alden Rd., New Rochelle, New York.

in the formula 21-23-21-21-19-17 (as in USNM* 32817 ♀, Paisano, Presidio Co., Tex.), or they may extend for almost two-thirds of the body length, and then disappear abruptly together with another pair of rows, as reflected in the formula 21-23-23-19-17 (BCB 4449 ♂, Port Isabel, Cameron Co., Tex.; AJK 1826 ♀, Brenham, Washington Co., Tex.). A much rarer condition, seen in only one specimen, resulted from the interposition of a single extra scale row on the midline of the back, resulting in the formula 21-22-22-21-19-17 (USNM 32814 ♀, Corpus Christi, Nueces Co., Tex.). An equally rare condition seen in only one specimen was the result of the retention of the pair of rows which is normally dropped just anterior to the vent; in this specimen (BCB 621 ♀, Lake La Joya, 10 mi. w. of Mission, Hidalgo Co., Tex.) the scale formula is 21-21-19-19. The reverse of this condition, *i. e.*, where a pair of rows is dropped well anterior to the usual point, was found in one specimen (AJK 2053 ♀, Mertzon, Irion Co., Tex.) with the formula 21-19-19-17. The final type of anomaly is characterized by the lack of a pair of scale rows on the anterior part of the body, with the missing pair subsequently reappearing, followed by normal scalation, thus: 19-21-21-19-17 (BCB 2893 ♂, 1 mi. s.w. of Reynosa, Tamaulipas, Mex.; USNM 104638 ♂, Rio Sta. Maria, nr. Progreso, Chihuahua, Mex.; BCB 4032 ♂, 3 mi. s.e. of Eola, Concho Co., Tex.).

There is no discernible association between these various aberrations and sex, or geographic origin.

Ventrals. Baird and Girard (1853, p. 37) found a ventral count range of 145-163 in the 10 specimens which comprised the type series of *marcianus*, and later writers (Ruthven, 1908; Van Denburgh, 1922; Schmidt and Davis, 1941; Smith, 1942) who have treated this species have reported substantially the same limits of variation. However, I find the full range of ventral counts in 225 specimens of *marcianus* is from 140 (USNM 20853 ♀, Fort Clark, Kinney Co., Tex.) to 173 (USNM 60234 ♂, Cañon del Muerto, Apache Co., Ariz.).

In female specimens of *marcianus* from southwestern Oklahoma and that part of Texas lying east (approximately) of Long. 100°, as well as in females from the Mexican states of Tamaulipas (as far south as Lat. 22° 45′), Nuevo León, Coahuila, and the extreme eastern parts of Durango and Chihuahua, the ventral count is quite homogeneous, ranging from 140 to 162 (av. 149.1 ±3.92). However, a relatively abrupt transition in the female ventral count takes place along the eastern frontier of the Great Plains in west-central Texas,

*Abbreviations used for collections: USNM—United States National Museum; CNHM—Chicago Natural History Museum; BCB—private collection of Bryce C. Brown; AJK—private collection of Albert J. Kirn; EHT-HMS—Edward H. Taylor-Hobart M. Smith collection; CAS—Chicago Academy of Sciences.

Oklahoma, and Kansas, so that specimens from localities lying to the west of this natural barrier in these three states and from points west of the eastern bastion of the Stockton Plateau in the big bend of Texas, as well as the states of New Mexico, Arizona, California, and the Mexican states of Chihuahua and Sonora, show a ventral count range of 150 to 166 (av. 156.8±3.21). These ventral count ranges are very pronounced, since 75 out of 79 eastern females (95%) have a count of 155 or less, while 48 out of 60 western females (80%) have a count of 156 or more. That this difference is highly significant and does not arise from random sampling errors is shown by the fact that the difference between the means is much greater than four times its standard error (D/S.E.=12.38). Hence, 123 out of 139 females (88.5%) can be correctly identified as to an eastern or western origin (as defined above) on the basis of the ventral count alone.

A similar geographic differentiation is found in male specimens. Snakes from eastern Texas, southwestern Oklahoma, and the northeastern Mexican states enumerated heretofore, have ventral counts ranging from 146 to 158 (av. 152.4±2.92), while male specimens from the western areas of the United States and Mexico (as delineated above) vary from 153 to 173 (av. 161.1±3.85). Out of 42 eastern males, 37 (88%) have ventral counts of 155 or less, while 41 western males (93.2%) have ventral counts of 156 or more. The difference between the means of the two samples is highly significant, being 11.79 times the standard error of the difference. A total of 78 males out of 86 (90.6%) can be correctly identified as to an eastern or western provenance on the basis of the ventral count alone.

Caudals. Recently published data by various authors established a caudal count variation of from 62 to 79 for *Thamnophis marcianus*, but in the specimens available to me I find a range of 61 (BCB 1251 ♀, 2 mi. s.w. of Mendoza, Caldwell Co., Tex.) to 83 (BCB 4020 ♀, 5 mi. n.e. of Eden, Concho Co., Tex.). In 30 eastern males the caudal count ranges from 64 to 81, while in 47 eastern females the caudal count spread is from 61 to 77. A count of 73 or more is found in 23 out of 30 males (77%), while a count of 72 or less characterizes 42 out of 47 females (89%). These differences are highly significant and indicate a prominent sexual dimorphism in the caudal count. The sexes in western specimens display a similar dimorphism in the caudal count, for 32 western males have a full caudal range of 69 to 82, while 39 females have a range of 62 to 83. A count of 70 or more is found in 31 western males (97%), while 31 out of 39 females (79.5%) have a caudal count of 69 or less.

Despite the prominent sexual dimorphism in caudal counts, there is no significant difference in this character which legitimately can be ascribed to a

geographic trend. The sexes of the two populations are almost identical in their caudal counts. However, although the caudal count is in itself of no value as a dichotomous character for distinguishing between the eastern and western populations, the combination of ventrals plus caudals shows a highly significant association with geographic origin. In 47 eastern females the range of combined ventrals and caudals is from 207 to 239; the average is 217.7 ± 6.31. By contrast, in 39 western females the combined ventrals and caudals vary from 213 to 241 and average 225 ± 5.38. That the difference between these two samples does not arise from random sampling errors is shown by the fact that the standard error of the difference between the means enters the difference 5.71 times. Eastern and western males are even more sharply distinct than are the females; 30 eastern males show a range of 214 to 236 in their combined ventrals and caudals and average 225 ± 5.28, while 30 western males vary from 225 to 255 and average 236 ± 5.85. Again, this difference is highly significant, the difference between the means being 7.64 times its standard error. Out of a total of 47 eastern females, 36 (76.5%) specimens have a combined ventral and caudal count of 221 or less, while 29 western females out of a total of 39 (74.5%) have a count of 222 or more. In the 30 eastern males, 26 (86.6%) have a combined ventral and caudal count of 231 or less, while of the 30 western males 23 (76.7%) have a count of 232 or more.

Supralabials. The normal supralabial count in *Thamnophis marcianus* is 8—8; however, certain aberrations have been seen in 22 out of 225 specimens studied. The frequencies of the various supralabial counts, and their association with the eastern and western populations, by sex, may be seen in Table I.

Table I. Variation in Supralabials

	–Number of Specimens–			
Supralabial Formula	eastern ♂	eastern ♀	western ♂	western ♀
6—6				1
6—7	1			
7—7	1			
7—8	6	4	5	
8—8	33	74	38	58
8—9	1	1	1	1
	42	79	44	60

The frequency of supralabial aberration in the eastern and western populations differs slightly (11.5 per cent in eastern specimens, 7.7 per cent in western specimens) and is not significant. However, examination of the supralabial frequency table shows that 15 out of 22 cases of aberration occur in

males. A chi-square value of 9.25 confirms the association between sex and supralabial abnormality.

Infralabials. The normal infralabial formula in *marcianus* is 10—10; there are, however, a considerable number of variations which occur; not less than 54 specimens out of 225 examined (24%) display some form of infralabial abnormality, as shown in Table II.

Table II. Variation in Infralabials

Infralabial Formula	eastern ♂	eastern ♀	western ♂	western ♀
	-Number of Specimens-			
8—9				1
8—10				1
9—9		1	1	1
9—10	6	3	3	3
9—11		1	1	
10—10	32	63	36	40
10—11	3	6	3	6
11—11	1	5		7
12—12				1
	42	79	44	60

There is no significant association between infralabial variation and sex (male aberration rate 20.9 per cent; female aberration rate 25.9 per cent), or between infralabial variation and geographic origin, although western females show a somewhat higher rate of aberration than do eastern females or males generally.

Ruthven (1908, p. 24, 29), in discussing labial variation in the garter snakes, has postulated that "the number of upper and lower labials are correlated . . . . a reduction in the supralabials is associated with a decrease in the number of infralabials." Quite possibly this hypothesis is borne out in other species of *Thamnophis,* but in the series of *marcianus* included in this study no such correlation or association is evident to a significant degree. In 18 cases of supralabial reduction only 5 specimens exhibit a simultaneous reduction in the infralabial count, while 5 other specimens show a simultaneous increase in the number of infralabials. However, it is found that aberration *per se,* in either the upper or lower labials, tends to be associated with aberration in the opposite set of labials. Out of 73 instances of supralabial or infralabial abnormality, 10 specimens show dual aberrations; *i. e.,* departure from the normal count in both upper and lower labials simultaneously. That this degree of bi-abnormality is indicative of some factor other than mere chance is shown by a chi-square value of 18.24 in testing the association of aberration in one set of labials with the simultaneous appearance of aberration in

the other set. Presumably, some kind of selectivity is operative under certain conditions, such that a concomitant deviation is effected in both the upper and lower labials. There is no significant association between labial bi-abnormality and sex, or geographic origin.

Oculars. The preoculars in *Thamnophis marcianus* are almost always 1—1; only three instances of aberration have been noted: a female specimen with preoculars 2—1 (BCB 2893, 1 mi. s.w. of Reynosa, Tamaulipas, Mex.), another female with preoculars 2—2 (USNM 32804, Rio Grande River, at Boquillas, Brewster Co., Tex.), and a male with preoculars 3—3 (CAS 12442, Musquiz Creek, 9 mi. s.e. of Fort Davis, Jeff Davis Co., Tex.).

The postoculars are not nearly so stable as the preoculars, considerable variation having been observed, as shown in Table III.

Table III. Variation in Postoculars

	Number of Specimens			
Postocular Formula	eastern ♂	eastern ♀	western ♂	western ♀
2—2	1			
2—3			1	
2—4			1	
3—3	14	21	14	14
3—4	10	10	10	15
4—4	17	48	17	29
4—5			1	2
	42	79	44	60

A formula of 3—3 or 4—4 must be considered normal insofar as 77 per cent of all specimens seen fall within one or the other of these two categories. A formula of 4—4 is more prevalent, since it occurs approximately 1.75 times more frequently than does the 3—3 count. There is no significant degree of association between the postocular count and sex, or geographic origin. There is likewise no significant association between postocular aberration and sex, or geographic origin.

Dentition. The maxillary teeth in 20 specimens of *marcianus* vary from 21 to 24, the last three teeth being much larger than any of their predecessors. Some minor degree of association between the maxillary tooth count and geographic origin is apparent, so far as a count of 24 has been found 5 times in 9 western specimens but occurs only once in the 11 eastern specimens examined.

The dentary teeth vary from 27 to 29 in 15 specimens from all parts of the range. The dentary tooth count is 28 in 12 specimens, 27 in two specimens, and 29 in one.

There is no detectable association between maxillary and/or dentary tooth counts and sex.

Pattern and Color. Thamnophis marcianus has been recognized generally as a rather pallid garter snake, possessing a checkerboard pattern dorsally plus a vertebral and a pair of lateral light stripes. In addition, the species is characterized by a prominent light postrictal blotch, followed by a dark nuchal spot. The belly is generally unmarked, except for a small spot on each end of the individual ventral scutes. Most importantly, the lateral stripe (when evident) has been held to be restricted invariably to the third dorsal scale row, at least anteriorly.

The type of *marcianus* (a large female), has the lateral stripe situated on the third scale row for the greater length (about three-quarters) of the body, and on the second and third rows, and ultimately the second row only, on the posterior part of the body. The vertebral stripe varies from one scale row in width (up to about the middle of the body), to one row plus two half rows (for the posterior part of the body), and ultimately occupies two scale rows just prior to the level of the vent. The belly is uniform tan, with a single, small, sharply-defined dot on the ends of each ventral scute, or sometimes with both dots and a small blotch on the anterolateral portion of each scute. The labials are bordered heavily with black both anteriorly and posteriorly, their centers being mostly light. There is a prominent postrictal light crescent on each side of the head, followed by a heavy nuchal blotch. Most of these characters are well illustrated in Baird and Girard's plate of *marcianus* (1854, pl. 3).

A number of deviations from the pattern and color of the type, and of the majority of specimens, have been observed. For example, in USNM 92754, 15 mi. n.w. of Dickens, Dickens Co., Tex., the dorsal stripe is very sharply defined, and for practically its entire length it is only two-thirds to three-quarters of a scale row wide. In USNM 92755, from the same locality, the vertebral stripe is slightly wider, just occupying a full scale row. Other specimens with vertebral stripes varying from one-half to one scale row in width are: USNM 71755, Somerset, Bexar Co., Tex.; USNM 78623, Victoria, Victoria Co., Tex.; USNM 17557, Tucson, Ariz.; USNM 852, Ft. Yuma, Calif.; USNM 95183, 38 mi. s.e. of Reynosa, Tamaulipas, Mexico. There is no association between provenance and the width of the dorsal stripe in *marcianus;* despite some variations, as noted above, the majority of specimens agree with the type.

Smith (1942, p. 114) has laid considerable stress on the importance of the width of the vertebral stripe in diagnosing the recently-described *Thamnophis ruthveni* (Hartweg and Oliver, 1938). According to Smith, the dorsal

stripe in *ruthveni* is restricted to the vertebral scale row, and the species is thereby differentiated from *marcianus* which has the dorsal stripe occupying a scale row plus half of each of the adjacent scale rows. I have seen only a single specimen of *ruthveni* (CNHM 40432 ♀, Tehuantepec, Oaxaca); this individual, with 145 ventrals and 61 caudals is not distinguishable from a great many *marcianus* on any basis other than the combined count of ventrals and caudals. Its pattern and color are duplicated by many *marcianus;* the vertebral stripe, for example, is no narrower than in CNHM 28819, Hacienda La Mariposa, Coahuila. Doubtless *ruthveni* is a distinct form, but almost certainly, a statistical study of the known specimens will show it to be very close to *marcianus.* Even the apparent hiatus between the range of *ruthveni* and that of *marcianus* is much narrowed by CNHM 38592♂, Villa Juarez, Tamaulipas (approx. Lat. 22°45′, Long. 99°), which closes the gap between these two species to approximately 500 miles. Apparently, *ruthveni* is a direct derivative of *marcianus*, via the Sierra Madre del Oriental; it may well be that an annectent population still exists between the known ranges of *ruthveni* and *marcianus.* The geographical relationships of these two species are illustrated almost perfectly in Gloyd's map of the distribution of *Crotalus atrox* (1940, p. 206).

The position of the lateral stripe has for long been considered highly important in the definition of the various forms of *Thamnophis.* In *marcianus* the lateral stripe is characteristically on the third scale row anteriorly, and for the greater length of the body. Yet in some snakes of this species which are not otherwise different from the majority of *marcianus*, the lateral stripe involves the third and fourth dorsal scale rows anteriorly, as in USNM 21820 and 21822, both from the Colorado River, 10 mi. below Yuma, Arizona, and USNM 852, Ft. Yuma, California. In these specimens, the lateral stripe occupies the third and fourth scale rows on the anterior fifth of the body, is restricted to the third row for the middle three-fifths of the body, and occupies the second and third scales rows on the last fifth of the body.

The ventral color and pattern in *marcianus* shows a moderate range of variation, from an ashy white to a clouded slatey gray, with a slightly darker median area in each ventral scute. The anterolateral dark spots and dots are variable, most specimens having the spots, many lacking the dots.

THE TYPE LOCALITY

Baird and Girard's original description of *Eutaenia marciana* (1853, p. 36) stipulates no more exact type locality than simply "Red River, Ark." Ruthven (1908, p. 58) has identified the type locality more closely by stipulating

"Cache Creek in what is now Oklahoma." Ruthven's designation is only approximately correct; actually, the type locality can be placed with greater specificity.

In the jar containing the type of *marcianus* (USNM 844 ♀), is a slip of paper with the following data: "Ind. Terr. betw. Camp 5 and Red R. 20 My 52. Marcy." Fortunately, this information, taken in conjunction with Marcy's published log (1854), permits the computation of his daily route in terms of present-day geography and place names, and thereby makes possible the determination of the type locality of *marcianus* with considerable exactness.

Marcy's historical explorations commenced on May 2, 1852, on which date he started from Fort Belknap (about a mile south of what is now New Castle, Young County), Texas. The expedition traveled in a northeasterly direction along the Little Wichita River, until the Red River was encountered, and thereafter proceeded to follow the Red River on the south (Texas) bank for several days. On May 12th, the Red River was crossed at the point of its confluence with the Big Wichita River. From the 13th to the 16th of May, the party traveled a total of slightly more than 15 miles, proceeding first along Cache Creek (a tributary of the Red River, in Cotton Co., Oklahoma) and then along the high ridge which runs between Deep Red Run (a major tributary of Cache Creek) and the Red River. By May 18th, the party had traveled approximately another 25 miles, continuing in a generally westerly (and slightly northerly) direction along Deep Red Run, and made Camp No. 4 just above the confluence of Slough Creek and Deep Red Run (in eastern Tillman County, Oklahoma). On May 19th, due to a severe rainstorm, no further progress was made. On May 20th, Camp No. 5 was pitched on the banks of Slough Creek at a point approximately 4.4 miles n.w. of Camp No. 4, the traveling on this day having been along Slough Creek. As nearly as can be determined, using Marcy's compass bearings and computed mileages, Camp No. 5 was situated at a point approximately 2.5 miles e.n.e. of the present-day town of Hollister, Tillman County, Oklahoma. Marcy's report stresses that due to the heavy rainfall on the previous day, very rough going was encountered on the 20th; it therefore seems reasonable to believe that the type of *marcianus*, which was collected on the 20th, must have been taken somewhere between Camps 4 and 5 along Slough Creek. In the light of this information, it is suggested that the type locality of *T. marcianus* be restricted to the vicinity of Slough Creek, east of Hollister, Tillman County, Oklahoma.

TAXONOMIC SUMMARY

In the light of the geographic and biometric evidence reported here, it is readily apparent that the species *Thamnophis marcianus,* as heretofore recognized, is composed of two vicarious forms. One, the nominate race, ranges from southwestern Oklahoma through eastern and central-western Texas to the Llano Estacado and the Stockton Plateau, and south to extreme eastern Chihuahua, northeastern Durango, and southern Tamaulipas. The other race, for which the name *Eutaenia nigrolateris* Brown (1889, p. 421) is available, occupies the western part of the range of the species *(sensu lato),* from western Texas and the western Plains Border in Oklahoma and Kansas, west to southeastern California, and south to Sonora and Chihuahua (Fig. 1). These two subspecies may be defined as follows:

Thamnophis marcianus marcianus (Baird and Girard)

1853 *Eutaenia Marciana* Baird and Girard, Cat. N. Amer. Rept., p. 36. *Type locality:* Red River, Ark. (vicinity of Slough Creek, east of Hollister, Tillman Co., Okla.).

Diagnosis: Dorsal scale rows 21-21-19-17. Ventrals (male) 146-158 (av. 152.4 ± 2.92), 155 or less in 88 per cent of specimens; (female) 140-162 (av. 149.1 ± 3.92) 155 or less in 95 per cent of specimens. Caudals (male) 64-81, 73 or more in 77 per cent of specimens; (female) 61-77, 72 or less in 89 per cent of specimens. Combined ventrals and caudals (male) 214-236 (av. 225 ± 5.38), 231 or less in 86.6 per cent of specimens; (female) 207-239 (av. 217.7 ± 6.31), 221 or less in 76 per cent of specimens. Supralabials 8–8, infralabials 10–10, preoculars 1–1, postoculars 3–3 or 4–4. Maxillary teeth 21-24, usually 23 or less; dentary teeth 27-29. Lateral stripe on third dorsal scale row anteriorly, and on second and third, or second only, posteriorly. Dorsal stripe occupying one-half or more of the vertebral scale row, and usually about half of each of the paravertebral scale rows. A yellow postrictal crescent.

Range: Southwestern Oklahoma, eastern and central-western Texas to the Llano Estacado and the Stockton Plateau; Nuevo León, Coahuila, Tamaulipas, northeastern Durango, and extreme eastern Chihuahua.

Specimens studied:

OKLAHOMA: *Comanche Co.*—7 mi. n. of Cache (CAS 3902); 5 mi. n. of Cache (CAS 3903); 5 mi. n.e. of Cache (CAS 3868-9). *Tillman Co.*—vicinity of Slough Creek, east of Hollister (USNM 844, TYPE).

TEXAS: *Atascosa Co.*—Benton (EHT-HMS 559). *Bee Co.*—Beeville (USNM 44305). *Bexar Co.*—8 mi. s.w. of Somerset (AJK 1325, 1625, 1765A, 2066-7, 2081, 2096, 2099); Somerset (USNM 71755); San Antonio (USNM 10713); 16 mi. n.e. of

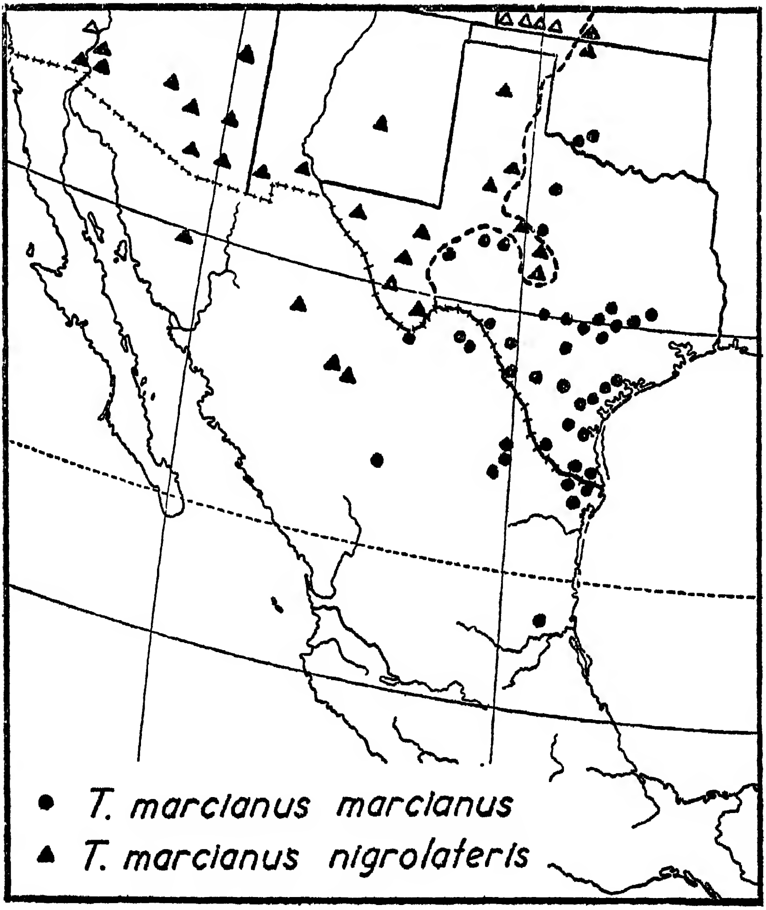

Figure 1. Distribution of the races of *Thamnophis marcianus*. Solid symbols stand for county records of specimens examined; hollow symbols denote accepted and determinable published records. The heavy dashed line in Kansas, Oklahoma, and Texas marks the eastern border of the Great Plains Province, except for the Edwards Plateau section.

San Antonio (AJK, no number). *Caldwell Co.*—2 mi. s.w. of Mendoza (BCB 1250-2). *Cameron Co.*—Brownsville (USNM 1369, 25399, 32803); Port Isabel (BCB 4449, USNM 851); no specific locality (USNM 17048-54). *Comal Co.*—Fischer's Store (BCB 1872). *Duval Co.*—San Diego (USNM 15664). *Fayette Co.*—Ruthersville (USNM 860). *Goliad Co.*—5 mi. n.e. of Goliad (CAS 12406). *Guadalupe Co.*—Seguin (USNM 35634). *Hays Co.*—San Marcos (BCB 64); 2.5 mi. e. of Wimberley (BCB 2718). *Hidalgo Co.*—McAllen (USNM 82288-9); Lake La Joya, 10 mi. w. of Mission (BCB 65, 621). *Irion Co.*—Mertzon (AJK 2053). *Kendall Co.*—4 mi. e. of Bergheim (BCB 63). *Kerr Co.*—Quinlan Creek, nr. Kerrville (USNM 22329). *Kinney Co.*—Fort Clark (USNM 20853-4). *Live Oak Co.*—3 mi. e. of Three Rivers (AJK 1848). *Maverick Co.*—Eagle Pass (USNM 1418). *Nueces Co.*—Corpus Christi (USNM 32805, 32811, 32814). *Pecos Co.*—15 mi. n.e. of Fort Stockton (USNM 92884). *Reagan Co.*—20 mi. n. of Big Lake (AJK 2048-9). *Runnels Co.*—Ballinger (AJK 2196). *Shackelford Co.*—2 mi. e. of Albany (CNHM 27721). *Travis Co.*—Austin (BCB 66, 1753). *Valverde Co.*—nr. Devils River (USNM 32810). *Victoria Co.*—Victoria (USNM 32809, 78623). *Washington Co.*—Brenham (AJK unnumbered adult ♀ and 15 young, also nos. 1826, 2093, 2106, 2253-5, 2270, 2304-6, 2309, 2375, 2490-2). *Zapata Co.*—nr. Zapata (EHT-HMS 562). *Zavala Co.*—Crystal City (AJK 2009). County uncertain: "32nd Parallel" (USNM 45594).

MEXICO. COAHUILA: Sierra del Carmen (CNHM 47071, 47076-78); Hermanas (CNHM 47080). CHIHUAHUA: Ojos del Diables (USNM 30837); Santa Helena Cañon (CNHM 26135). DURANGO: betw. Lerdo and La Goma (USNM 105295). NUEVO LEON: Sabinas Hidalgo (EHT-HMS 28653); Mamulique Pass, 20 mi. s. of Sabinas Hidalgo (EHT-HMS 5287); 8 mi. w. of Monterrey (EHT-HMS 23615). TAMAULIPAS: 1 mi. s.w. of Reynosa (BCB 2893); 38 mi. s.e. of Reynosa (USNM 95183); Charco Escondido (USNM 849); Matamoras (USNM 861—three specimens, USNM 5491, 15344); Villa Juarez (CNHM 38592). State uncertain: "15 leagues n. of Guerrero" (USNM 46583).

Thamnophis marcianus nigrolateris (Brown)

1889 *Eutaenia nigrolateris* Brown, Proc. Acad. Nat. Sci. Philadelphia, p. 421. *Type locality:* Tucson, Arizona.

Diagnosis: Essentially similar in all respects to *T. marcianus marcianus*, except as follows: ventrals (male) 153-173 (av. 161.1 ± 3.85), 156 or more in 93.2 per cent of specimens; (female) 150-166 (av. 156.8 ± 3.21), 156 or more in 80 per cent of specimens. Caudals (male) 69-82, 70 or more in 97 per cent of specimens; (female) 62-83, 69 or less in 79.5 per cent of specimens. Combined ventrals and caudals (male) 225-255 (av. 236 ± 5.85), 232 or more in 76.7 per cent of specimens; (female) 213-241 (av. 225 ± 5.38), 222 or more in 74.5 per cent of specimens. Maxillary teeth 21 24, often 24.

Range: From the Great Plains and the Stockton Plateau in Texas, and the Plains Border in Oklahoma and Kansas, west to southeastern California, and south to Sonora and Chihuahua.

Specimens studied:

ARIZONA: *Apache Co.*—Cañon del Muerto (USNM 60234). *Cochise Co.*—1 mi. s.w. of Chiricahua (CAS 12444). *Graham Co.*—1.5 mi. e. of Solomonsville (CAS 9235, 10434-5); 10 mi. e. of Safford (CAS 9987); 5.5 mi. s. of Safford (CAS 11009, 11246); 6 mi. s. of Safford (CAS 11188, 11190-93, 11195-8). *Maricopa Co.*—1 mi. n. of Mesa (CAS 5299); Phoenix (USNM 55990-1); Gila Bend (USNM 61632). *Pima Co.*—Sabino Cañon Rd., 7 mi. n.e. of Tucson (CNHM 51751); 21 mi. n.e. of Tucson (CNHM 51752); 8 mi. n.e. of Tucson, 2000 ft. (CAS 13697); 2 mi. n. of Sahuarita (CAS 10349); Tucson (USNM 16947, 17442, 17557). *Pinal Co.*—3 mi. w. of Florence (CAS 10300); 0.2 mi. n. of Florence (CAS 14212). *Yuma Co.*—Colorado River, 10 mi. below Yuma (USNM 21819-22).

CALIFORNIA: *Imperial Co.*—Fort Yuma (USNM 852—two specimens).

KANSAS: *Barber Co.*—Lake City (CNHM 23366).

NEW MEXICO: *Dona Ana Co.*—nr. Mesilla Dam (USNM 100895). *Hidalgo Co.*—Animas Valley, at 5000 ft. (USNM 44502). *Lincoln Co.*—10 mi. n. of Capitan Mts. (USNM 44393). County uncertain: "near Lat. 32°" (USNM 1370).

OKLAHOMA; *Woods Co.*—Alva (CNHM 565).

TEXAS: *Borden Co.*—7 mi. n. of Vincent (BCB 4041). *Brewster Co.*—Rio Grande River, at Boquillas (USNM 103679, 32804); 1 mi. s.w. of Boquillas (CNHM 26260). *Carson Co.*—nr. Conway (USNM 95250); 9 mi. w. of Conway (USNM 99770). *Coke Co.*—3 mi. w. of Robert Lee (AJK 1940). *Concho Co.*—6 mi. w. of Eden (BCB 4016); 5 mi. n.e. of Eden (BCB 4020); 3 mi. s.e. of Eola (BCB 4032). *Dickens Co.*—Dickens (USNM 92752-5). *Hudspeth Co.*—Fort Hancock (USNM 20656). *Jeff Davis Co.*—Musquiz Creek, 9 mi. s.e. of Fort Davis (CAS 12422-43). *Linn Co.*—7 mi. n. of O'Donnell (USNM 92811). *Menard Co.*—Menard (BCB 1757). *Presidio Co.*—Paisano (USNM 32813, 32816-7). *Reeves Co.*—10 mi. s. of Toyahvale (CAS 12407-15).

MEXICO. CHIHUAHUA: Rio San Pedro, betw. Chihuahua City and Naica (EHT-HMS 5320, 5419, 5423); 10 mi. n. of Ciudad Delicias (USNM 105293); Rio Santa Maria, nr. Progreso (USNM 104634-41). SONORA: No specific locality (USNM 7235).

This race is known also from Picacho, Imperial County, and Riverside Mountain, Colorado River, Riverside County, California (Van Denburgh, 1922, p. 851); also Spring Creek, Morton County and Meade, Meade County (Taylor, 1929, p. 59), Liberal, Seward County, and Clark County (no locality), Kansas (Smith, 1946, p. 99). Benjamin Shreve has furnished scale counts on two additional specimens (MCZ 39979, Tucson, Arizona; and MCZ 14149, Las Cruces, Doña Ana County, New Mexico). Although included in Smith's recapitulation of Mexican *Thamnophis*, the record for Sonora was overlooked by Bogert and Oliver in their recent review of the herpetofauna of this Mexican state (1945). It is unfortunate that the sole record for Sonora lacks more specific data; as Stejneger points out (1940, p. 204), a number of Emory's specimens (of which this is one) were collected in the region around

what is now the international boundary between Arizona and Sonora, but which at the time of collection was wholly Mexican (Sonoran) territory. Hence, there is little probability that the exact provenance of this specimen will ever be known. Nonetheless, with *nigrolateris* known from many localities in Pima and Cochise Counties, Arizona, there can be little reasonable doubt that this race occurs in Sonora.

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The Genus *Connodontus* (Coleoptera: Pselaphidae)

Orlando Park
Northwestern University

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The Bulletin of the Chicago Academy of Sciences was initiated in 1883 and volumes 1 to 4 were published prior to June, 1913. During the following twenty-year period it was not issued. Volumes 1, 2, and 4 contain technical or semi-technical papers on various subjects in the natural sciences. Volume 3 contains museum reports, descriptions of museum exhibits, and announcements.

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Howard K. Gloyd, Director of the Museum

Committee on Publications:

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Bulletin of the Chicago Academy of Sciences

The Genus *Connodontus* (Coleoptera: Pselaphidae)

Orlando Park
Northwestern University

Connodontus is a genus of batrisine pselaphids known so far only from Africa. Five species are recognized, including two described in the present report. These populations are poorly known, both taxonomically and ecologically. Both sexes are reported only for the genotype. No species has been recorded more than once, e.g. at the time of its description. None of the species have been studied while alive. The species are known from a few specimens and no data are available on intraspecies morphologic, physiologic, and ecologic variation. Finally, one of the new species departs so far from the traditional concept of the genus that it required subgeneric separation with the result that the genus had to be redefined and revised.

The taxonomy of the genus is in an unsatisfactory condition. This is especially unfortunate since all species of *Connodontus* are known from the nests of termites, and with the exception of a single specimen, all are known *only* from the nests of these hosts. Not only do we not have information on the rôle of these pselaphids in the complex termite society, but their termite hosts are very closely related indeed and there is the possible question of subspeciation in both hosts and inquilines.

COMPOSITION OF THE GENUS

Connodontus was erected by Raffray (1882, p. 52-53, pl. 2, fig. 17) for the genotype, *acuminatus*, described at that time. This is still the best known species, and is the only one in which both sexes are discriminated. *C. acuminatus* was collected twice by Raffray in the province of Bogos, Abyssinia; once five or six specimens were taken beneath a stone with termites, and on a second occasion a single specimen was taken from beneath a stone but no ter-

mites were found. Raffray concluded that since the last mentioned individual was found alone, the association of *acuminatus* with termites was accidental.

Wasmann (1904, p. 3) disagreed with Raffray's conclusion. He reported on a single specimen that had been collected by Trägardh in a nest of *Macrotermes natalensis* (Haviland) near Ghrab el Aish, north of Fashoda, on the White Nile, Sudan. Wasmann suggested that *acuminatus* was an habitual resident of termite nests, and further suggested that the beetle he studied fed on the numerous mites *(Uropoda)* that were attached to the termites or were loose in the nest. The author agrees with Wasmann's suggestion that *Connodontus acuminatus* is an inquiline of termites, and probably feeds on the mites in the termite nest. This latter suggestion is in harmony with the direct observations and/or suggestions that non-symphilic pselaphids generally are predaceous and devour mites (Denny, 1825; Raffray, *in* Reitter, 1909, p. 201; Donisthorpe, 1927; Davey, 1945; Park, 1942, 1947a, b).

In the paper under discussion, Wasmann *(op. cit.)* found several differences between his specimen and the description of *acuminatus*, and closed his comparison with the statement that should these differences really exist, he suggested that his specimen was the type of a new species for which he proposed the name *termitophilus.*

Silvestri (1905, p. 347) found several specimens of *Connodontus* in the nest of *Macrotermes bellicosus* (Smeathman) near Adi Ugri, Abyssinia. Silvestri identified these pselaphids as *C. termitophilus* Wasmann.

Raffray (1908, p. 146) stated that the pselaphids reported by Silvestri *(op. cit.)* were not *termitophilus* Wasmann, but belonged to a new, unpublished species for which he gave "Silverstrii, Raffr. i.l." without description, and a few lines later: "Sylvestrii, Raffray, nom. nov. *(termitophilus*, Silvestri, (nec Wasmann)."

In this 1908 paper Raffray (1) cited *termitophilus* Wasmann as a questionable synonym of *acuminatus*, and (2) stated that the findings of additional individuals of *Connodontus* with termites established this genus as termitophilous.

In the following year, Raffray (1909, p. 19) described the species collected by Silvestri *(op. cit.)* and named it *Silvestrii.* In the 1909 paper Raffray considered the genus as having three species: *acuminatus*, *termitophilus*, and *Sylvestrii*, with the first two being closely related. This brings the genus up to date, later lists by Raffray (1911, 1923-24) not altering the composition.

Of the two new species to be described shortly, one- *emersoni* —is in the *Connodontus* tradition, but the other *manni* departs from the rest of the genus in a basic generic character. All previous species had a pair of conspicuous lateral carinae on either side of the first tergite, but *manni* lacks the external lateral carina on each side of the first tergite. Accordingly, *manni*

will not key out to *Connodontus* in the 1908 Raffrayan arrangement for pselaphid genera of the world, and instead runs to wholly incompatible and widely separated aggregates (*Ophelius*, *Trisinus*, *Cylindroma*, *Batrisocenus* and *Cratna*). On the other hand, *manni* is typical *Connodontus* in all other respects, including the unique abdomen of the genus. Consequently it was felt that a new subgenus, *Manniconnus*, should be erected to contain *manni* as its type, and that *Connodontus* should be revised.

DIAGNOSTIC CHARACTERS OF CONNODONTUS, AS REVISED

Species of the genus *Connodontus* may be separated from other known Batrisini by the following combination of structural features.

1. Pronotum lacking longitudinal sulci.
2. Body cylindrical and fusiform.
3. Abdomen unique: conical and acuminate, with the intersegmental membranes very long so that the abdomen can be contracted some thirty per cent of its total length, the segments capable of being telescoped.
4. Five visible tergites in both sexes; six sternites visible in the male and five sternites visible in the female.
5. Lateral abdominal margins represented by either a pair of carinae on the first two tergites (subgenus *Connodontus*), or by a single carina on the first two tergites (subgenus *Manniconnus*). Where two carinae are present, they are subparallel, the external subentire and the internal extending to apical three-fourths of segmental length. Tergites not excavated.
6. Posterior coxae close together, with the matasternum acutely rounded between their subglobular mesial articular portions.

KEY TO THE KNOWN SPECIES OF CONNODONTUS

1 First tergite with a pair of subparallel carinae on each side (subgenus *Connodontus*, s.s.) 2

First tergite with a single carina on each side (subgenus *Manniconnus*) *manni* new species.

2 (1) Head, base of pronotum and first three tergites densely punctate-granulate, not shining; first three tergites bisected by an entire, median, longitudinal carina 3

Body shining, punctures sparse; first two tergites each with a median, longitudinal carina 5

3 (2) Each elytron with a deep dorsal stria to center of elytral length *termitophilus* Wasmann.

Elytra with dorsal stria absent 4

4 (3) Six sternites visible male *acuminatus* Raffray.
Five sternites visible female *acuminatus* Raffray.

5 (2) Pronotum with a large lateral antebasal fovea on each side connected by a wide, deep, medianly sinuate transverse sulcus *silvestrii* Raffray.
Pronotum with a minute, indistinct lateral antebasal fovea on each side just discernibly connected by a faint, shallow, poorly defined transverse impression *emersoni* new species.

I have followed Raffray in considering *termitophilus* as a species. I do not know *termitophilus* and *silvestrii* except from their original descriptions. The key character used to discriminate *termitophilus* from *acuminatus* is a strong one, but the difficulty lies in interpretation of Wasmann's remarks. He states *(op. cit.*, p. 4) "und einer durch eine tiefe, bis zur Flügeldeckenmitte reichende Längsfurche abgegrenzten Schulterbeule" and cites in distinction to this Raffray's description of *acuminatus.* If Wasmann refers to the dorsal stria, the two species are probably distinct, but if the deep, longitudinal furrow refers to the subepipleural sulcus on elytral flank, then the two types must be examined comparatively.

Connodontus emersoni new species

Type (Female). Plate I, fig. 1, 2.

Measurements. Head (apical margin of clypeus to cervicum) 0.44 mm. long x 0.42 mm. wide; pronotum 0.49 x 0.42 mm.; elytra 0.68 x 0.7 mm.; abdomen 1.25 mm. long contracted and 1.66 mm. long extended. For this exceptional abdominal situation see below. Total length 3.3 mm.

Body uniform light reddish brown, with polished integuments; mandibles, maxillary palpi, distal half of antennal segments, and femora yellow. Pubescence moderately long but sparse.

Head with a pair of small vertexal foveae located on a line passing through posterior third of eyes, these foveae isolated and not connected by an interfoveal sulcus. Vertex gradually elevated from occiput but not otherwise modified. Front with a pair of large, deep, hemispherical cavities, each cavity located between an antennal articulation and a longitudinal ridge; this frontal ridge is carinoid and bisects the front, and from a lateral view is sinuate. Clypeus broad, subtriangular, steeply declivous with a convex surface and not otherwise modified, merging gradually with the front. Mandibles well developed, with acute rami; left mandible crossed over right. Maxillary palpi four-segmented; segment I minute; II elongate-arcuate, basally slender, apically gradually swollen; III subtriangular, short, slightly longer than wide; IV

fusiform, slightly longer and wider than second, with a minute pinkish scar at center of external face (similar to that of the batrisine *Oxarthrius (Baroxarthrius) escharus* of Panama), and with a minute palpal cone at apex of segment. Eyes well developed, at about center of head, composed of about 52 facets. Ventral surface of head medianly, transversely gibbous, with a median, longitudinal carina from center to apical margin, and the basal half involved in a deep, conical fossa. Cervicum dorsally divided into four subequal, slightly concave areas by three longitudinal carinae, of which the median is the longest; ventral surface of cervicum with a median longitudinal carina from apical fifth into gular fossa noted previously. Antennae long and of the general proportions shown in Plate I; antennal segment I large and subpyriform; II to X obconical; III to X with basal halves bearing closely placed longitudinal striae (at high magnification each stria is composed of minute granules).

Pronotum of proportions as illustrated; disk evenly and strongly convex, simple; at basal fourth there is a very small perforate lateral fovea on each side; these indistinct lateral foveae connected by a straight, very shallow, weakly defined transverse impression.

Elytra with sloping, unarmed humeri; each elytron with two small, nude basal foveae; sutural fovea apparently much larger as a consequence of its position at basal outlet of sutural stria; sutural stria entire but weakly formed; discal fovea petite; flank of elytron with a longitudinal carina from ventrad of humeral angle to apical elytral margin, this carina paralleled by a weakly formed longitudinal sulcoid impression that appears to arise apically in a minute subhumeral fovea.

Abdomen with five visible tergites in the proportions illustrated; tergite I and II with lateral margins represented by a pair of strong, subentire, subparallel carinae; I and II each with a strong, median, cuneiform carina that extends through basal third of first, and through basal two-fifths of second tergite; V with apex deeply incised as illustrated.

Abdomen with five visible sternites; sternite I with basal margin medianly erected into a short, semicircular process, the median point of which fits into a minute notch of the longitudinally sulcoid metasternum; sternite V simple, rounded-triangular.

Legs relatively simple; femora normally inflated, basal halves bearing closely placed longitudinal striae as described for antennal segments; tibiae slightly arcuate, external faces similarly striate; tarsi typical of batrisines, with a pair of stout, unequally developed tarsal claws.

Paratype (Female). This second specimen agrees with the above description with one exception: the basal elytral foveae are much larger, deeper and more conspicuous. Plate I shows the more conspicuous basal foveae of the

paratype and, to this extent at least, describes variation within the population.

This description is based on two females (type and paratype) in the author's collection. They were collected by Dr. Alfred Emerson, June 9, 1948, in the fungus garden of a castle-like nest (four by four feet) of the termite *Macrotermes natalensis* (Haviland), at Rifflart, Belgian Congo, 14 km. south of Leopoldville, at an altitude of 310 m.

To the author at least, the most remarkable feature of *emersoni* is the abdomen, and it deserves special attention. Contrary to the condition found in Pselaphidae as a whole, there is an extensive alutaceous intersegmental membrane between the first and second, second and third, and third and fourth abdominal segments. When these specimens were received they were in alcohol, and the relatively long and acuminate abdomen was rendered much longer as a consequence of these membranes being fully extended. After mounting, the abdomen contracted as the membranes became folded between the segments. Plate I shows an intermediate condition between full expansion and contraction. The intersegmental membranes of *emersoni*, on measurement, made up one-third of the total abdominal length when expanded. This suggests that the abdomen could be elongated and contracted by one-third of its total length. This further suggests a much more movable abdomen than has been reported for any other pselaphid. Raffray (1908, p. 146) has already pointed out that the long and conical abdomen of *Connodontus* is paralleled in Pselaphidae only by the New Zealand genus *Eleusomatus,* and that these two pselaphid genera approached the hypothetical ancestral staphylinoid condition in this respect. Raffray had nothing to say on the intersegmental membranes. This is not to say that *Connodontus* is primitive by virtue of this staphylinoid abdomen. Rather, it is the author's view that the presumably highly motile abdomen of *emersoni* is a special adjustment to its life in the complex termite society. If this is tenable, it is an approach to the spectacular development of the abdomen in many genera of termitophilous and myrmecophilous staphylinids.

Connodontus manni new species

Type (Female). Plate I, fig. 3. Plate II.

Measurements. Head (apical margin of clypeus to cervicum) 0.47 mm. long x 0.47 mm. wide; pronotum 0.53 x 0.46 mm.; elytra 0.71 x 0.74 mm.; abdomen 1.28 mm. long contracted and 1.69 mm. (?) long extended. For this exceptional abdominal situation see relevant remarks in the description of *emersoni.* Total length 3.4 mm.

In general more robust than *emersoni.* This can be seen in the plates of the two species and is a conspicuous factor in the different habitus of *manni.* Coloration and pubescence as described for *emersoni.*

Head as described for *emersoni*, with the following differences. Vertex is strongly vaulted from the occiput to a point on a line through the anterior margins of the eyes (Pl. I, fig. 3); vertex with several, large, coarse punctures. Hemispherical cavities of the front deeper than in *emersoni*, and the longitudinal ridge separating them is medianly much more sinuate. The minute pinkish scar on the fourth segment of the maxillary palpi of *emersoni* is absent in *manni*, and this distal segment is relatively broader in *manni*. The median, longitudinal carina of the ventral surface of the head is less well developed in *manni*. Cervicum radically different from *emersoni*, the lateral carinae of the dorsal surface of the cervicum being absent in *manni* (Pl. II). Antennae in general similar to *emersoni*, and of the general form and proportions illustrated. The distal antennal segment of *manni* is much larger than this segment in *emersoni*, and the parallel, longitudinal striae at the base of the antennal segments III to X, so well developed in *emersoni*, are rudimentary in *manni*.

Pronotum of *manni* much more robust, with the poorly defined transverse, antebasal impression much wider, so that in profile (Pl. I, fig. 3) the pronotal disk is more gibbous.

Elytra of *manni* broader. Each elytron with a single antebasal fovea. This latter is the sutural fovea, the discal fovea being absent. Metathoracic wings present.

Abdomen with five visible tergites as illustrated. First tergite apically inflated so that this segment is almost as wide as the elytra, and much wider than the first tergite of *emersoni*. First and second tergites of *manni* lack the external lateral carina on each side. This is the most fundamental difference between *emersoni* and *manni*, and has served to place *manni* as the type of a new subgenus. The median cuneiform carina is relatively shorter on the first two tergites than in *emersoni*. Apical margin of third tergite almost straight, in contrast to this margin in *emersoni*, where it is arcuate. Apical margin of fourth tergite deeply incised, in contrast to this margin in *emersoni* where it is simply arcuate. Fifth tergite as in *emersoni* but longer.

Sternites as in *emersoni*.

Legs as in *emersoni* but the femora are more clavate in the distal two-thirds, and the parallel, longitudinal striae at the femoral bases, so prominent in *emersoni*, are rudimentary in *manni*.

The above description is based on the type specimen. This species is represented by three females, the type and two paratypes. The type and one paratype are deposited in the United States National Museum (USNM 59078), the other paratype is in the author's collection. I am indebted to Dr. Charles Seevers for calling my attention to this material, to Dr. E. A. Chapin for

making it available for study, and to Dr. Alfred Emerson for the identification of the host termite. All three pselaphids were collected by Dr. W. M. Mann at Bendija, Liberia during the Smithsonian Firestone expedition of 1940, in the nest of *Macrotermes natalensis* (Haviland) variety *tumulicola* Sjöstedt.

There are several matters of intraspecies variation in *manni* that deserve attention. All three specimens show the strong, cuneiform internal carina on each side of the first tergite, but under very strong illumination and high magnification the side of the tergite shows a very fine line where the external carina occurs in the genotype and in *emersoni.* It was the presence of this trace that confirmed the desirability of placing *manni* in a separate subgenus.

The development of the intersegmental membranes of the abdomen is as great in *manni* as in *emersoni* and in the two paratypes of the former, the abdomen is so contracted that there appear to be only four visible tergites on casual inspection. The reason for this is that the fourth tergite has been retracted beneath the third so that only the margin can be studied without relaxing in hot water.

The cervicum also requires an additional note. Whereas the species lacks the three strong dorsal cervical carinae of *emersoni,* there are in *manni,* on either side of the median carina, a pair of very minute carinal lines. The development of the secondary cervical carinae varies between the three specimens. They are not shown in the plate because of their small size.

It is also worth noting that the basal elytral fovea in the type has its floor occupied by two secondary foveae or pits, and that in all three specimens there is a coarse, oval puncture on the crest of the vertexal vault.

GENERAL REMARKS

1. The present composition of the genus *Connodontus* is unsatisfactory. This condition will continue until there is a substantial increase in the number of available specimens for study and of field data with which to work.

At present there are several alternative combinations. There may be only three species populations known, e.g. *acuminatus*, *silvestrii,* and *manni.* If this is so, then the reported differences between *acuminatus* and *termitophilus*, and between *silvestrii* and *emersoni,* may represent (a) subspeciation, in which case there should be a correlation of structural variation with differences in areal range or some other isolating mechanism; (b) normal variation as between the sexes; (c) errors in the original descriptions; (d) omissions in the original descriptions. Study of a few specimens precludes both statistical manipulation and any effort at finding an area of intergradation if subspecies are involved.

On the basis of what is known, the most likely hypothesis is that there are five species populations known in the genus, as set forth in the preceding key.

2. Unfortunately the more extensive information on the host termites does not assist too much in the solution of the question of subspeciation in the pselaphids associated with them. Only two hosts are known, both of which belong to the same subgenus, *Bellicositermes.* These hosts are *Macrotermes bellicosus* (Smeathman) and *Macrotermes natalensis* (Haviland). In a personal communication, the author was assured by Dr. Emerson that these two hosts are very closely related, in fact that some specialists in Isoptera had thought that they might represent subspecies. Furthermore, the variety *natalensis tumulicola*, the host of *manni*, may itself be a subspecies, but lack of data on range has limited this line of thought. Both hosts occur over a very wide, but essentially similar, range in the Ethiopian Region (Emerson, 1928, p. 445-450), and both hosts appear to be adapted for savannah areas and only here and there have penetrated equatorial forest. Consequently, there is no series of subspecies of host, each with its own inquilinous population of *Connodontus;* the hosts occupy broadly similar areal ranges, and ecologically similar habitats.

So far, *acuminatus*, *termitophilus*, and *silvestrii* are known only from the northeastern ranges of their hosts (Abyssinia and the White Nile area of the Sudan). A fourth species, *emersoni*, is known only from the Leopoldville area of the Belgian congo, not closer than 1,200 miles from these three congeners. The fifth species, *manni*, known only from Liberia, is known no closer than 2,600 miles from the first three listed, and is 1,900 miles from the single collection made of *emersoni.* This extensive range of *Connodontus* is much less extensive than the known ranges of the hosts. Patently, we need more collections of these pselaphids.

3. There remains the rôle of *Connodontus* in the termite society. Relatively few pselaphids are known from the nests of termites (Wasmann, 1904; Park, 1942, 1946, 1947), and even less is known of their ecological interrelations with their hosts.

The record cited earlier (Raffray, 1882) of taking a specimen of *acuminatus* from beneath a stone, unaccompanied by host termites, has at least two interpretations. First, it is unexceptional to find myrmecophilic pselaphids apart from their hosts. For example, *Fustiger cornicen* Reichensperger (1933) has been taken from the forest floor in Costa Rica; *Decarthron monoceros* (Schaufuss), an inquiline of army ants, comes to lights at night (Park, 1942, 1945) in Panama and Dutch Guiana; facultative inquilines, including certain species of *Tmesiphorus* and *Batrisodes* are taken as often in floor mold as in

ant galleries (Park, 1932, 1933, 1947). Therefore, it is not unlikely that termitophiles may be taken apart from their hosts on occasion.

Second, it is possible that the specimen of *Connodontus acuminatus* under discussion was near or with its host, but that the latter were unobserved.

Lack of trichomes, and presence of well-developed mandibles and maxillae, suggest that *emersoni* and *manni* are not symphiles of termites, but rather occupy the rôle of tolerated inmates or synoeketes. They probably feed upon mites in the host nest, and possibly upon injured members of the society.

ABSTRACT

The Ethiopian termitophilus genus *Connodontus* contains five known species of pselaphid beetles. These are *acuminatus* Raffray, the genotype; *termitophilus* Wasmann; *silvestrii* Raffry; and two new species, *emersoni* and *manni.*

C. emersoni was collected near Leopoldville, Belgian Congo in a nest of *Macrotermes natalensis* (Haviland); *C. manni* was taken near Bendija, Liberia in a nest of *M. natalensis tumulicola* Sjöstedt. Both of these new species are probably synoeketes of their hosts.

The anatomy of *Connodontus,* especially the remarkable intersegmental abdominal membranes, is discussed. The paper includes generic revision, in which a new subgenus, *Manniconnus,* is erected, with *manni* as its type; a key to the species; and general remarks on host-inquiline distribution and the position of these pselaphids in the complex society of their host termites.

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PLATE I

1 *Connodontus emersoni* new species, dorsal aspect

2 *Connodontus emersoni* new species, profile of head and pronotum, semidiagrammatic

3 *Connodontus manni* new species profile of head and pronotum, semidiagrammatic

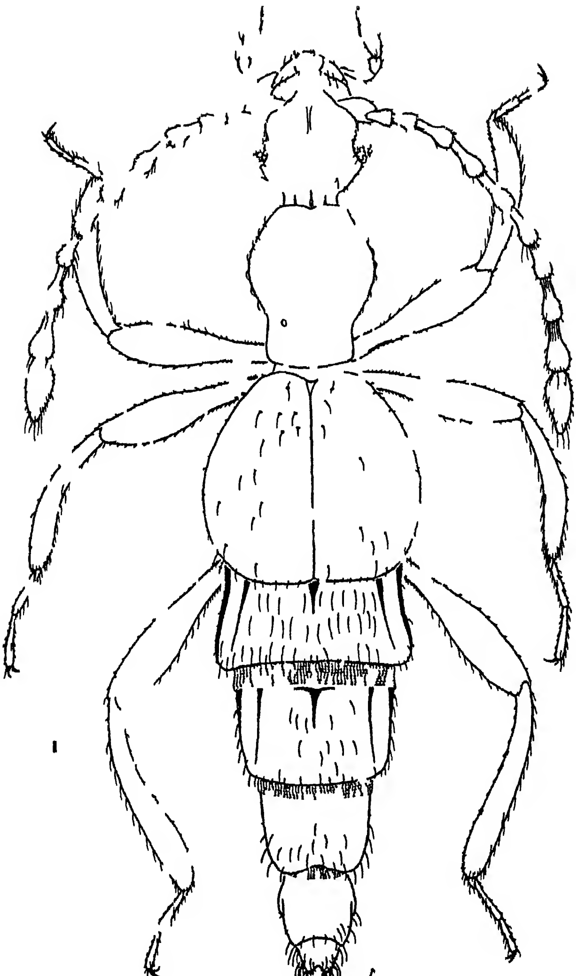

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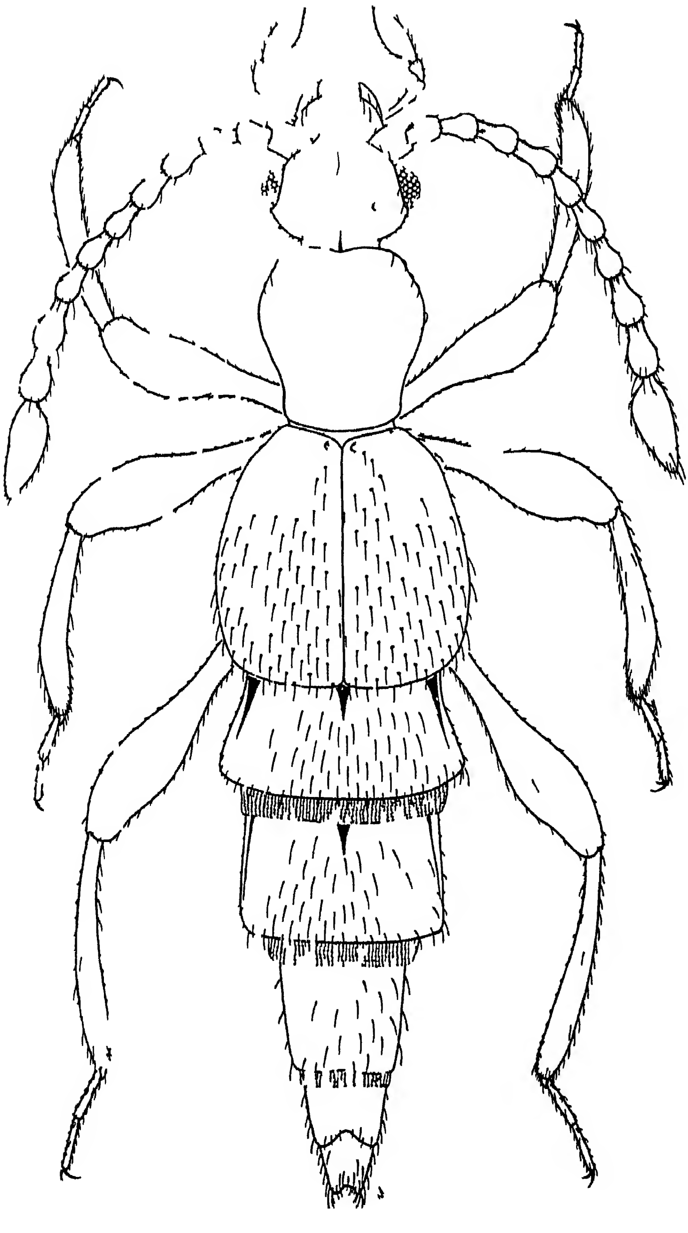
PLATE II

Connodontus manni, new species, dorsal aspect.

Note: The author is indebted to Miss Marie Wilson, one of his graduate students, for the meticulous care with which the illustrations in this paper were prepared.



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Pselaphid Beetles of an Illinois Prairie: The Fauna, and its Relation to the Prairie Peninsula Hypothesis

Orlando Park, Stanley Auerbach, and Marie Wilson
Northwestern University

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The Bulletin of the Chicago Academy of Sciences was initiated in 1883 and volumes 1 to 4 were published prior to June, 1913. During the following twenty-year period it was not issued. Volumes 1, 2, and 4 contain technical or semi-technical papers on various subjects in the natural sciences. Volume 3 contains museum reports, descriptions of museum exhibits, and announcements.

Publication of the *Bulletin* was resumed in 1934 with volume 5 in the present format. It is now regarded as an outlet for short to moderate-sized original papers on natural history, in its broad sense, by members of the museum staff, members of the Academy, and for papers by other authors which are based in considerable part upon the collections of the Academy. It is edited by the Director of the Museum with the assistance of a committee from the Board of Scientific Governors. The separate numbers are issued at irregular intervals and distributed to libraries and scientific organizations, and to specialists with whom the Academy maintains exchanges. A reserve is set aside for future need as exchanges and the remainder of the edition offered for sale at a nominal price. When a sufficient number of pages have been printed to form a volume of convenient size, a title page, table of contents, and index are supplied to libraries and institutions which receive the entire series.

Howard K. Gloyd, Director of the Museum

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Bulletin of the Chicago Academy of Sciences

Pselaphid Beetles of an Illinois Prairie: The Fauna, and its Relation to the Prairie Peninsula Hypothesis

Orlando Park, Stanley Auerbach, and Marie Wilson

Northwestern University

CONTENTS

INTRODUCTION

The great majority of species of the family Pselaphidae inhabit forests (Raffray, 1908; Park, 1942). Furthermore, the forest community is considered as the ancestral or historical habitat of the family (Park, 1947a). Nevertheless, other niches are occupied by these beetles. Some ten to fifteen per cent of the species are either partially or wholly dependent upon social insects for food and shelter. The majority of these inquilines are members of ant societies; a relative few live with termites. Still other pselaphids inhabit grasslands, deserts, and a variety of intermediate situations.

Grassland pselaphids, as such, have been studied very little; no habitat has been examined quantitatively for these beetles primarily. The present study is concerned with the faunal aspects of the pselaphid beetle population of Peacock Prairie.

Peacock Prairie is a tract of approximately ten acres, located in Cook County, Illinois, some eight miles west of Evanston, on Milwaukee Road (Pl. I, Fig. 1). Its floristics have been reported by Paintin (1929). Miss Paintin did not find the evidence conclusive as to whether or not this area was virgin prairie in the strict sense. The evidence available to her, both from interviews of old residents and an analysis of the plants present, strongly suggested that the tract was native grassland, the soil of which had not been broken by plow.

The prairie lies just west of the Glenwood Beach of Glacial Lake Chicago, and is probably of swamp origin following the Wisconsin glaciation. It is part of the Peacock estate which was Indian territory prior to a government land grant in 1842. Miss Paintin learned from James Long, whose grandfather was the original owner, that Peacock Prairie had never, to his knowledge, been systematically grazed by cattle and had not been plowed.

The flora would seem to support this view. Characteristic prairie plants present on Peacock Prairie include *Silphium integrifolium*, *Silphium laciniatum*, four species of *Solidago*, and six species of *Aster*. On the other hand, the presence of certain introduced weeds suggests that this is not virgin prairie, and we are informed that the tract has been burned over on more than one occasion.[1]

The beetles were obtained from this area by two methods. First, starting with November, 1947, relatively regular weekly samples of prairie sod and its associated soil were brought back and subjected to a Berlese analysis. Each sample covered 0.08 square meter of sod, and weighed on an average of 5000 grams. Second, boards were laid down at random on the prairie floor, following the general technique of Cole (1946), and these served to "trap" pselaphids on the relatively moist, cool, and dark lower surfaces. These latter collections were started in April, 1948. Both collection methods, and soil temperatures, were continued through December, 1948. The Berlese analyses and soil temperatures are to be continued into June, 1949. These quantitative data, including populations and seasonal influences, are in the process of analysis for a future report.

THE PSELAPHID FAUNA OF PEACOCK PRAIRIE

In the first place, the paucity of specific references to grassland pselaphids should be emphasized. Very few general studies of the grassland community mention these beetles in their faunal lists. For example, the neglected

[1] Personal communication from Dr. Max E. Britton.

Fig. 1. Peacock Prairie, a relatively undisturbed fragment of original prairie near Evanston, Illinois. Note two species of compass plants and meter stick in foreground.

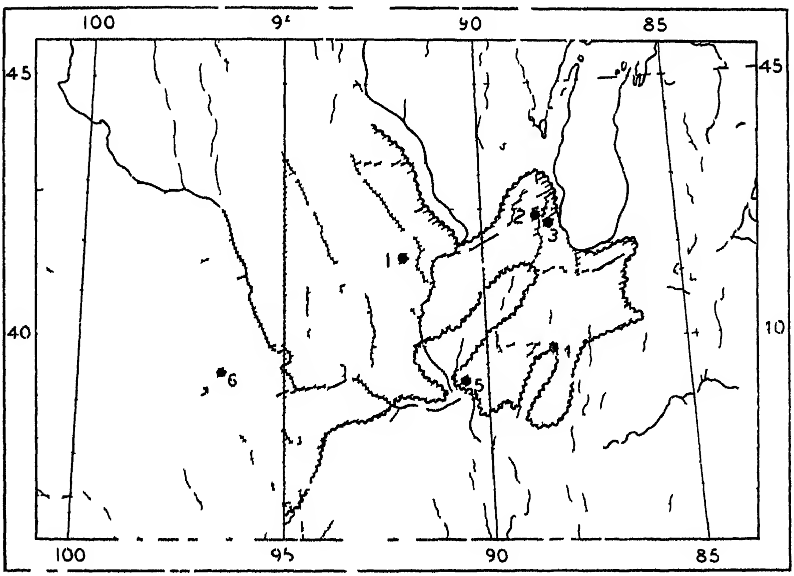

Fig. 2. Known distribution of the pselaphid beetle *Reichenbachia* [illegible] Casey, an example of a postglacial steppe relict in the Prairie Peninsula. Localities are (1) Iowa City, Iowa; (2) Algonquin, Illinois; (3) Peacock Prairie near Evanston, Illinois; (4) Monticello, Illinois; (5) Grafton, Illinois; (6) Onaga, Kansas. Roughly indicated outline of Prairie Peninsula after Transeau 1935. Scale: 1 inch equals 250 miles.

paper of Cameron (1917) on the Holmes Chapel district of Cheshire, England, the analysis of prairie in central Illinois by Shackleford (1929), and the comprehensive study of Nearctic grassland by Carpenter (1940) do not list pselaphids. This is surprising in view of their abundance in the sod of Peacock Prairie. Probably pselaphids did occur in these three areas cited, and either the collecting methods employed did not obtain them, or if specimens were obtained they were not discriminated. Certainly these beetles play a rôle in the prairie community that more or less parallels that played by pselaphids in the forest community, namely the nocturnal feeding upon mites and other small arthropods of the floor stratum (Park, 1947 a, b).

On the positive side, Morris (1922) collected a specimen of *Brachygluta fossulata* (Reichenbach) in the top inch of soil of a manured meadow in March at Rothamsted Experimental Station, Harpenden, Hertfordshire, England. This species is not restricted to grassland apparently since Denny (1825) collected it on several occasions from moss on tree stumps, and it is known from "sandy places" near Bexley.

Thompson (1924) reported *Euplectus kunzei* Aubé from Aberystwyth, Wales.[2] In this detailed report one specimen was taken in July from the surface three inches of sod of a pasture that had been grazed as well as used for growing hay. A second specimen was taken in February from between three and nine inches deep in the sod, from cultivated land that had been fertilized heavily and used three years previously for the growing of potatoes. Attention is called here to the finding of this species deeper in the ground in February than in July, since this datum suggests that the population may have a vertical seasonal migration.

Three adults of *Decarthron longulum* LeConte were reported from the careful study by Wolcott (1937) on pastures and meadows in northern New York. Isolated records are equally infrequent. Blatchley (1910) records *Rhexius insculptus* LeConte collected by sweeping blue-grass in Indiana, and Park (1947 b) records *Batrisodes striatus* (LeConte) collected by sifting dried grass along margins of meadows in New York.

Five species of Pselaphidae were collected from Peacock Prairie. To simplify identification of this fauna, the following key is provided. In reality

[2] *Euplectus kunzei* Aubé is a synonym of *Euplectus brunneus* Grimmer according to Raffray (1908, 1910), Champion (1909) and Reitter (1909). The species of the genus *Euplectus* are thought to be inhabitants of forest floor litter, and especially of decaying logs and tree-holes. For example, Reitter (1909) gives the habitat of *brunneus* as damp beech leaves on the forest floor, and in the United States the numerous species are usually taken in a variety of forest niches. The finding of *brunneus* in grassland sod parallels similar situations discussed later in this paper.

this key is a key to genera, since but one species in each of five genera was taken. On the other hand, it is felt that the intensive methods used regularly over such a small and uniform area have discovered all of the normal residents.[3] Even so, five species of pselaphids from one prairie is a respectable showing. In a forthcoming conspectus of the pselaphid fauna of the Chicago Area (Park, 1949) some 43 species are listed. Thus the prairie species represent about 12 per cent of the local fauna--a fauna that is preponderantly associated with the forest habitat.

KEY TO THE PSELAPHIDAE OF PEACOCK PRAIRIE

1 Antennae geniculate, with the first segment very long, at least half as long as the funicle *Rhexius insculptus* LeConte.
Antennae not geniculate and the first segment much shorter than described above 2

2 (1) Pronotum with a fine, longitudinal carina that bisects the basal third, from basal margin nearly to disc; minute species, distinctly less than one millimeter long *Bibloplectus integer* (LeConte).
Pronotum with base not longitudinally bisected by a carina; larger species, distinctly more than one millimeter long 3

3 (2) Distal segment of maxillary palpi very long and conspicuous, with a slender, pedunculate base and the distal two-thirds swollen and lengthily setose *Pselaphus fustifer* Casey.
Distal segment of maxillary palpi not as described 4

4 (3) General body pubescence in the form of scales *Pilopius lacustris* Casey.
General body pubescence in the form of short, normally pointed setae (Plate II) *Reichenbachia subsimilis* Casey.

Before turning to more general aspects of this study a few words of annotation for each of these five species are desirable.

Bibloplectus integer (LeConte). This is the smallest and most abundant species in the prairie fauna under discussion, measuring about eight-tenths of a millimeter in length. It has a closely related southern ally, *Bibloplectus ruficeps* (LeConte) of the Gulf States. Formerly *integer* was generally considered as a synonym of *ruficeps*. Bowman (1934) quite properly noted that this course was inadvisable until more evidence was at hand. Most of the records for *ruficeps* in the northern parts of the United States probably refer to *integer*.

[3] An exception may be the discovery of myrmecophilous pselaphids in nests of ants on the floor of Peacock Prairie. So far, Berlese samples of such nests have not yielded any pselaphid beetles.

These two species are not easily separated. They differ primarily in size and in the punctulation of the pronotal disk. Both of these characters tend to vary in a given population but in general *ruficeps* has the pronotal disk wholly or almost devoid of punctures and is seldom more than seven-tenths of a millimeter in length, whereas *integer* has the pronotal disk distinctly punctulate and is generally eight-tenths of a millimeter or slightly more in length.

It may be that *integer* and *ruficeps* will prove to intergrade in a long series from the Gulf of Mexico to Michigan and Wisconsin, in which case *integer* may be considered as a subspecies of *ruficeps.* This is not the place to present the evidence, where local issues are uppermost.

It would seem that *integer* can not be considered a prairie species in the strict sense. It is very abundant in Peacock Prairie, and has been taken from grass sod at Grafton, Illinois. On the other hand, it inhabits the tree holes in the upland oak-hickory forests of Palos Park, Illinois and occurs in leaf mold samples from forests of northern and central Illinois and Indiana.

Rhexius insculptus LeConte. This species is distinctive in the Chicago Area by reason of its elbowed or geniculate antennae. The case for *insculptus* is hardly more reassuring than that of *integer.* It will be remembered that Blatchley recorded *insculptus* from blue-grass in Indiana, and this species occurs sparingly in Peacock Prairie. On the other hand it occurs in forest floor leaf and log mold near New Lennox, Illinois. Outside of the local area the same situation appears to exist, since *insculptus* had been taken from grassland at Onaga, Kansas and from forests in the Steinhatchee River basin of Florida.

Pselaphus fustifer Casey. This species is the least abundant of the Peacock Prairie fauna. There is insufficient ecological data to discuss its habitat distribution.

Pilopius lacustris Casey. This appears to be the common species of its genus in the Great Lakes area but its discrimination from its allies, especially *piceus* (LeConte), and *zimmermanni* (LeConte) requires exact knowledge of sex, preferably by dissection.

Casey's *lacustris* is abundant at Peacock Prairie, and has been taken beneath stones in meadows near Chicago, and near Algonquin in McHenry County.

A point worth noting is that the tribe to which *Pilopius* belongs, the Ctenistini, includes a number of species that are typical of regions of great aridity; e. g., arid areas of the western United States, where vegetable mold is sparse. For example, of the nineteen Nearctic ctenistines, eight inhabit arid areas of Texas and Arizona, one is a western species, living with ants, and the remaining ten are distributed over the eastern United States. It may

be that *lacustris* is adjusted naturally to the relatively greater exposure of prairie conditions.

Reichenbachia subsimilis Casey. We are inclined to consider this species as more typical of the prairie habitat than any of the preceding species. The genus is the largest of the family, with more than 300 species. It is cosmopolitan with the exception of Australia and New Zealand, and preponderantly tropical in distribution. The great majority of the species are recorded from forests, but some are known from grassland and others have been taken in ant nests.

R. subsimilis is the second most abundant pselaphid from Peacock Prairie. It was described from Iowa, and is known from Onaga, Kansas and several prairie localities in Illinois. We have no forest records for this species. Because of its importance in the present study, this species has been illustrated (Plate II), and forms the central theme of the following section.

RELATION TO THE PRAIRIE PENINSULA HYPOTHESIS

Despite the general differences between forest and grassland, their respective pselaphid inhabitants probably perform the same rôles in both. That is, they are concerned indirectly with the formation of organic soils. These minute predators, and their allies, feed in part upon collembolans, mites and other herbivores of the floor stratum. In this way they tend to regulate indirectly the amount of floor mold readily available for bacterial action (Allee, Emerson, Park, Park and Schmidt; Park, 1947a).

Two of the five species collected at Peacock Prairie are also known from local forests. These two are *Bibloplectus integer* and *Rhexius insculptus.* By inference, these latter would seem to be adjusted to both prairie and forest floors. Of course, all five species may occur normally in both habitats. Such a view is not attractive when the differences between woodland and grassland are remembered. Such differences include the great differential in both the quality and quantity of humus, of floor debris, the quality and intensity of incident light, gradients in soil moisture, soil and air temperatures, rate of evaporation, relative humidity and wind velocity.

A third species, *Reichenbachia subsimilis,* is known only from prairie localities. The type locality is Iowa City, Iowa. As noted previously, it is known from Onaga, Kansas, and in addition to Peacock Prairie, we have this species from meadow or modified prairie from Algonquin, Grafton, and Monticello, Illinois. This suggests that the species is one in which the population is adjusted primarily for grassland conditions.

When these six known localities are mapped (Pl. I, Fig. 2), the further suggestion emerges that *Reichenbachia subsimilis* is a relict from a postglacial steppe fauna. This postglacial steppe or prairie peninsula included the Chicago Area (Gleason, 1922; Transeau, 1935; Schmidt, 1938). It is probable that after glaciation the local region became a prairie extension that was subsequently invaded by the northward advance of hardwood forests. These forests re-established a relatively continuous deciduous forest habitat in the area. Under such altered conditions the steppe peninsula pselaphids could either become exterminated, or adjust to the forested conditions, or emigrate westward into the grassland, or persist locally as relicts. On the basis of the known data, *Reichenbachia subsimilis* appears to be established in the western grassland, and to have remained in scattered meadows and prairie remnants in Illinois. Future collecting may alter, or justify, this hypothesis but in view of the general paucity of pselaphid records, the congruence between the supposed outlines of the prairie peninsula and the zoögeographic information available on this species seems convincing. Especially notable is the lack of records of this species from woodland in the Chicago Area, where the pselaphid fauna has been studied as much as feasible over the past two decades.

TABLE I

Pselaphidae Reported from Grassland and Meadows

Species	Locality	Source
1. *Rhexius insculptus* LeConte	Indiana	Blatchley, 1910
	Onaga, Kansas	Present Report
	Peacock Prairie, Illinois	" "
2. *Euplectus brunneus* Grimmer	Aberystwyth, Wales	Thompson, 1924
3. *Bibloplectus integer* (LeConte)	Peacock Prairie, Illinois	Present Report
4. *Melba sulcatula* Casey	Monticello, Illinois	Present Report
5. *Reichenbachia subsimilis* Casey	Iowa City, Iowa	Casey, 1897
	Onaga, Kansas	Present Report
	Algonquin, Illinois	" "
	Peacock Prairie, Illinois	" "
	Monticello, Illinois	" "
	Grafton, Illinois,	" "
6. *Brachygluta fossulata* (Reich.)	Harpenden, Herts.	Morris, 1922
7. *Decarthron longulum* (LeConte)	New York	Wolcott, 1937
8. *Batrisodes striatus* (LeConte)	New York	Park, 1947b
9. *Pselaphus fustifer* Casey	Peacock Prairie, Illinois	Present Report
10. *Pilopius lacustris* Casey	Peacock Prairie, Illinois	Present Report

A respectable number of species of pselaphids have been reported from various types of Nearctic grassland or its cultivated equivalents. Those known to the authors are gathered together in tabular form (Table 1). Some of these may prove to be chance records of typical woodland forms; others appear to be adjusted to both forest and grassland; still others may be as typical of prairie habitats as *Reichenbachia subsimilis* appears to be. Finally, future work will add to this list in all probability.

As a postscript, it should be emphasized that because of their small size, nocturnal habits, and indifferently known requirements, pselaphid beetles are not as suitable as indicators of forest or prairie conditions as are many plants and larger animals.

SUMMARY

A survey was conducted between November, 1947 and December, 1948 to obtain information on the pselaphid beetle population inhabiting the upper three inches of sod at Peacock Prairie, near Evanston, Illinois.

Five species of Pselaphidae were collected. These are *Bibloplectus integer* (LeConte), *Rhexius insculptus* LeConte, *Reichenbachia subsimilis* Casey, *Pselaphus fustifer* Casey, and *Pilopius lacustris* Casey.

Relatively regular weekly collections were made. These consisted of sod samples of 0.08 square meter, averaging 5000 grams wet weight, and by manual collecting from beneath boards placed at random over the prairie. The sod samples were Berlesed.

The species taken are discussed briefly in general terms, a key is provided for their identification, their distribution in the Chicago Area and their probable rôle in the grassland community are outlined.

Reichenbachia subsimilis is discussed as an example of a postglacial steppe relict in the Prairie Peninsula, and a table of Nearctic grassland pselaphids is given.

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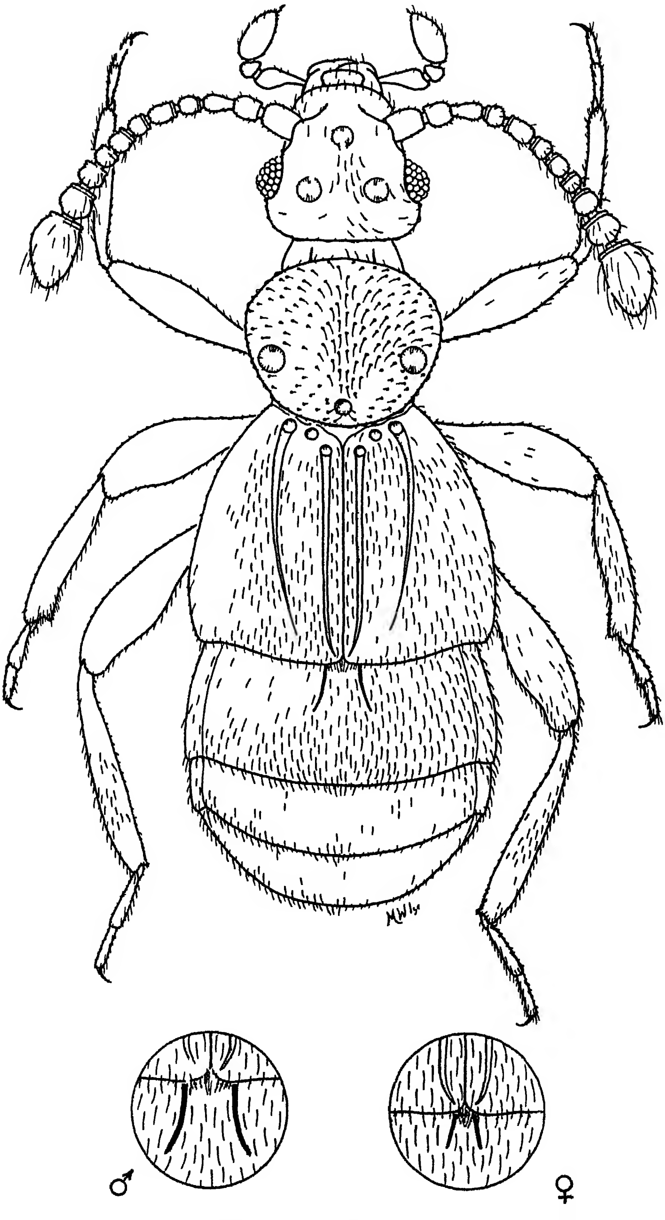

Dorsal aspect of a male *Reichenbachia subsimilis* Casey, a typical prairie pselaphid beetle. Length of beetle 1.2 millimeters. Circular insets show differences in basal abdominal carinae as between the sexes.

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The Identity of *Ameiva tesselata* Say

Hobart M. Smith and W. Leslie Burger

• • •

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Publication of the *Bulletin* was resumed in 1934 with volume 5 in the present format. It is now regarded as an outlet for short to moderate-sized original papers on natural history, in its broad sense, by members of the museum staff, members of the Academy, and for papers by other authors which are based in considerable part upon the collections of the Academy. It is edited by the Director of the Museum with the assistance of a committee from the Board of Scientific Governors. The separate numbers are issued at irregular intervals and distributed to libraries and scientific organizations, and to specialists with whom the Academy maintains exchanges. A reserve is set aside for future need as exchanges and the remainder of the edition offered for sale at a nominal price. When a sufficient number of pages have been printed to form a volume of convenient size, a title page, table of contents, and index are supplied to libraries and institutions which receive the entire series.

Howard K. Gloyd, Director of the Museum

Committee on Publications:

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Bulletin of the Chicago Academy of Sciences

The Identity of *Ameiva tesselata* Say*

Hobart M. Smith and W. Leslie Burger

An attempt to determine the exact type locality of *Ameiva tesselata* Say in James (1823a, p. 50) (= *Cnemidophorus tesselatus tesselatus* of recent authors) has led to the conclusion that the name has long been applied incorrectly, and actually refers to the species generally known as *Cnemidophorus grahami* Baird and Girard (1852b, p. 128).†

The original description appeared as a footnote by Say in James' account of Long's expedition to the Rocky Mountains (James, 1823a, p. 50-51). James' account was reprinted in a London edition which appeared the same year as the original Philadelphia edition. Changes in the London edition were few and minor, chiefly involving the placement of footnote material in the body of the text. Say's description appeared on pages 238 and 239 of volume 2. Both editions have become relatively rare, but in 1905 Thwaites reprinted the London edition, reverting however to use of footnotes as in the original Philadelphia edition. Thwaites also added rather numerous editorial comments of considerable value.

We have been able to examine only the original Philadelphia and the Thwaites editions. No noteworthy change from the original occurs in the description of Say's species as reprinted in Thwaites (1905, p. 43-44, vol. 16) other than the spelling of the specific name as *tessellata* rather than *tesselata*.

The specimens furnishing the basis for Say's description were observed by members of Long's Expedition to the headwaters of the Arkansas River, on July 19, 1820, somewhere in the near vicinity of a creek called Castle Rock Creek by James. This creek, according to Thwaites (1905, p. 44) is now

*Contribution from the University of Illinois, Department of Zoölogy and Museum of Natural History, Urbana.

†We have been able to complete this study only through the kind assistance of Karl P. Schmidt with the literature, and of Dr. Doris Cochran, Dr. Howard K. Gloyd, and Clifford Pope in providing access to much-needed comparative material.

known as Beaver Creek and is situated in eastern Fremont County in eastern central Colorado. The creek is a tributary of the Arkansas River, and lies well to the east of the Continental Divide. This locality is far from the range of the species which up to the present time has borne the name of *tesselatus*; in fact, that species does not cross the Continental Divide nor even very closely approach it from the west anywhere north of southern New Mexico (see Smith, 1946, map 35, p. 508). The expedition whose members observed the type specimens at no time crossed the divide, but remained eastward throughout its duration. Thus there is apparently no chance whatever that more westerly specimens could have been observed or captured by the expedition. While the range of C. *t. tesselatus (auct.)* is not thoroughly known, there is no indication whatever that any population belonging to it could exist, now or then, in the area of the type locality of *A. tesselata.*

The original description of Say's species follows:

"[July] 19th. [1820] This morning we turned our backs upon the mountains, and began to move down the Arkansa. It was not without a feeling of regret, that we found our long contemplated visit to these grand and interesting objects, was now at an end. More than one thousand miles of dreary and monotonous plain lay between us and the enjoyments and indulgences of civilized countries. This we were to traverse in the heat of summer, but the scarcity of game about the mountains rendered our immediate departure necessary.

"A large and beautiful animal* of the lizard kind (be- [p. 51] longing to the Genus Ameiva,) was noticed in this day's ride. It very much resembles the Lacerta Ameiva, as figured and described by Lacepede, but the tail is proportionably much longer. Its movements were so extremely rapid that

"*Genus Ameiva. A. *tesselata*. Say. Tesselated lizard.–The back and sides of the body and neck, are marked by nine or ten longitudinal lines, and eighteen or twenty transverse ones, dividing the whole surface in a tesselated manner, the interstitial quadrate spaces being black; these lines are light brown on the back, and assume a yellow tint on the sides; the scales of these portions of the body are very small, convex and rounded.

"The top of the head is olivaceous, covered by plates, arranged thus: [p. 51] 2 with an intermediate small one at their tips; 1, 2, 1 the largest, 2, and 3, superior orbits of the eyes with four plates, of which the two intermediate ones are much the largest; belly bluish-white; throat and neck tinged with yellow, and covered with somewhat larger scales than those of the back; anterior feet yellowish within, and covered with minute scales, on the exterior and posterior sides greenish-white with confluent black spots and large scales; posterior feet behind greenish-white, with confluent black spots and minute scales, the anterior side yellowish, covered with large scales; pores of the thigh very distinct and prominent; tail elongated, rounded, above light brown, with a few lines of black spots near the base; beneath yellowish-white, immaculate, the scales carinated, and placed in transverse series. Total length 1 foot, tail 8½ inches."

it was with much difficulty we were able to capture a few of them. . . [Description of country follows here.] . . . [p. 52].

"A little before noon, we crossed a small stream, which was called Castle Rock creek from a remarkable pile of naked rocks, and halted for dinner on the bank of the river."†

Most of the preceding description could fit specimens of either *tesselatus (auct.)* or *grahami*, the only forms potentially occurring in the indicated area and to which the description conceivably could apply. At least three characters, however, point toward *grahami:* (1) the bluish-white belly in conjunction with the peculiar dorsal pattern, (2) the "18 or 20 transverse lines," and (3) the "few lines of black spots near the base" of the tail.

Unfortunately, so far as ease of identification is concerned, some southeastern specimens of *C. tesselatus (auct.)* from New Mexico and Texas as well as specimens from certain other widely remote sectors, possess a dorsal pattern closely paralleling that of *C. grahami;* rarely the similarity is virtually exact, so that reliable identification by that means alone is impossible. However, this fact should not be permitted to detract from appreciation of the very great value of the dorsal pattern as an identifying characteristic of *C. grahami.* So far as comparison with the original description of *A. tesselata* is concerned, this apparent fact is important: those specimens of *C. tesselatus (auct.)* with a bold dorsal pattern resembling that of *C. grahami* almost always possess more numerous dark spots, either well-defined or diffuse, on the chest and, especially significantly, the throat. In *C. grahami* the *ventral* surface of the throat is unspotted, "immaculate" in the words of Say, except in occasional specimens which have two or three small distinct dark spots placed irregularly. The chest and abdomen are in some specimens immaculate, but more often are flecked with black in *C. grahami,* although the extent of marking averages less than in similarly marked *C. tesselatus (auct.).* Apparently nowhere in its range does the latter species exactly match the combination of the "yellowish-white, immaculate" venter and the checkered dorsal pattern of *C. grahami,* and of Say's description of *A. tesselata.*

The number of transverse light lines (18 or 20) mentioned by Say for *A. tesselata* is characteristic of *C. grahami,* but not of most *C. tesselata (auct.),* which more often have 24 to 30. None have been observed with so few transverse lines as 20.

The "lines of black spots near the base" of the tail commonly occur in *C. grahami,* seldom in *C. tesselatus (auct.)* in the eastern part of its range.

†Thwaites (1905, p. 44, vol. 16) states that "The distance travelled since leaving Royal Gorge indicates Beaver Creek, in eastern Fremont County, as probably the one here called Castle Rock Creek."

In addition to these three pattern characters, geographic probability very strongly favors conspecificity of *A. tesselata* Say and *C. grahami*, inasmuch as the latter is known to be widely distributed east of the Rocky Mountains, north at least to the central panhandle of Texas. It is true that the species has never been recorded elsewhere for Colorado, but its occurrence there is not an unreasonable possibility on grounds of biotic areas. The canyon habitat indicated by James likewise corresponds with the known preferences of *grahami*, notoriously a canyon, as opposed to plains, inhabitant.

Furthermore, if perchance the date of observation was incorrectly recorded, the itinerary of Long's party led only through areas known to be inhabited by *C. grahami*, never through the known range of *C. tesselatus (auct.)*. The expedition's route crossed the middle of the Texas panhandle, following the south fork of the Canadian River. It is entirely possible that the party observed the specimens of *A. tesselata* in this panhandle area, where *C. grahami* is well known, rather than in Colorado. Thus even if the date were erroneously recorded, the possibility that *C. tesselatus (auct.)* was involved is still remote and virtually nonexistent.

The exact status of the species formerly called *Cnemidophorus grahami* Baird and Girard is of considerable importance inasmuch as: (1) if it is identical with *C. tesselatus (auct.)* as Burt (1931) believed, no change whatever in nomenclature is required; (2) if it is a subspecies of *tesselatus (auct.)*, then only its name and that of *C. t. tesselatus (auct.)* will require a change; and (3) if it is a distinct species, rather extensive changes in nomenclature will result, for the name *tesselatus* will be removed completely from the species to which it has formerly been applied.

The problem of the status of the species *C. grahami (auct.)* has accordingly been reviewed again on the basis of literature and specimens locally available. While not numerous, the specimens examined do rather forcefully bear out the opinions of Strecker (1910, p. 8-13, pl. 1; 1915, p. 25), Van Denburgh (1924, p. 213), and Schmidt and Smith (1944, p. 85) that not one but two distinct species, *C. grahami* and *C. tesselatus (auct.)*, are involved. An apparently infallible distinction can be made on the basis of the dorsal pattern and mesoptychial scales. The pattern is of a bold, black-and-white, checkered effect, and the mesoptychial scales unmistakably large, in *C. grahami;* the mesoptychial scales are always small in *C. tesselatus,* and the dorsal pattern seldom like that of the former, characteristically rather faded, more reticulate, of finer dark lines, and with a stronger tendency toward formation of transverse bars or longitudinal lines, without the balance of both tendencies necessary to produce a prominent checkered appearance. Plates 117 and 118 in the Handbook of Lizards (Smith, 1946) accurately portray the differences

with the exception of figure c, plate 117 which is a ventral view of a specimen of *C. tesselatus (auct.)*.

Another apparently infallible difference between the two species concerns the size of the extreme anterior gular scales; they are very minute—as small as the smallest gulars in front of the mesoptychials—in *C. grahami*, but distinctly larger than the smallest gulars bordering the mesoptychials in *C. tesselatus (auct.)*.

The difference in coarseness of the dorsal pattern has been mentioned previously; counts upon series from sufficiently widely representative localities are not, however, available at the present time.

While the similarities between these two species are remarkable, the differences are inescapable and we believe unquestionably of specific, not subspecific, implication. The two species might well be regarded "sibling" species in the terminology of Mayr (1942, p. 151). As a final and perhaps clinching point in support of specific distinctness of the two forms, it is noteworthy that both occur together certainly in some and no doubt in many restricted areas; specimens of both are at hand from El Paso, Texas, and Van Denburgh *(loc. cit.)* records both from Las Cruces, New Mexico. Schmidt and Smith (1944, p. 85) likewise note the occurrence of both forms—in ecologically distinct zones, however– in the Chisos Mountain area of Brewster County, Texas. Of course the gross ranges of the two species have long been known to overlap very extensively in southwestern Texas and southeastern New Mexico.

Specimens examined from the critical area of range overlap are as follows.*

C. t. tesselatus (auct.):

Brewster Co., Texas Crooked Hills, 12 mi. e. of Chisos Mts., CA 4848-50; Boquillas, CA 4851-2; Hot Springs, CA 11516-9; Tornillo Flats, in Chisos Mts., CA 4841-2; Burnham Ranch, in Chisos Mts., CA 11515; Indian Peak, in Chisos Mts., CA 4843-7. *Valverde Co., Texas*—Langtry, CA 11513-4. *El Paso Co., Texas*—El Paso, UIMNH 1532. *Santa Fe Co., New Mexico* –Santa Fe, UIMNH 1533.

C. grahami (auct.):

Presidio Co., Texas Provenir, CNHM 46033-5. *El Paso Co., Texas*—El Paso, CNHM 29453-6. *Otero Co., New Mexico*—Tularosa, CNHM 2945-6.

That the name *C. grahami* has been correctly allocated in the past has been verified by examination of the cotypes, now U. S. National Museum 3096a-b. We hereby designate Number 3096a lectotype; it has 20-20 femoral pores and 216 dorsal scales from the posterior margin of the interparietal to

*CA—Chicago Academy of Sciences; UIMNH—University of Illinois Museum of Natural History; CNHM—Chicago Natural History Museum.

a line even with the posterior margins of the thighs; number 3096b has 214 dorsals, similarly counted. In both specimens distinct black markings are present on the anterior edges of the lateral ventrals; faint markings are present on the lower surface of the forelegs; chin and ventral surface of hind legs immaculate white. In the lectotype specimen there are 7 rows of regular, quadrangular spots, 18 from ear to thigh. In the paratype the rows are united to form crossbars, many of which cross one-half or more of the back; 19 bars from ear to thigh; 5 light stripes discernible medially.

As stated previously, the admission of (1) conspecificity of *Ameiva tesselata* Say with *Cnemidophorus grahami* Baird and Girard, and (2) the specific distinctness, from other named relatives, of the single species to which both of these names are applicable, most unfortunately requires rather extensive revision of present nomenclature in this group. The revision cannot be avoided on nomenclatural grounds since only zoological considerations are involved. The changes are as follows:

Cnemidophorus tesselatus (Say, 1823, p. 50-51) supersedes *grahami* Baird and Girard (1852b, p. 128).

Cnemidophorus tigris tigris Baird and Girard (1852a, p. 69*) replaces *C. tesselatus tesselatus (auct.; e. g.*, Smith, 1946, p. 421-424, pl. 118).

Cnemidophorus tigris aethiops Cope (1900, p. 582-584) replaces *C. tesselatus aethiops (auct.; e. g.*, Smith, 1946, p. 424-426, pl. 119).

Cnemidophorus tigris canus Van Denburgh and Slevin (1921, p. 97) replaces *C. tesselatus canus (auct.; e. g.*, Burt, 1931, p. 208-211).

Cnemidophorus tigris celeripes Dickerson (1919, p. 472) replaces *C. tesselatus celeripes (auct.; e. g.*, Burt, 1931, p. 202-205).

Cnemidophorus tigris martyris Stejneger (1891, p. 407) replaces *C. tesselatus martyris (auct.; e. g.*, Burt, 1931, p. 205-208).

Cnemidophorus tigris rubidus Cope (1892, p. 36, pl. 12, fig. 1) replaces *C. tesselatus rubidus (auct.; e. g.*, Burt, 1931, p. 199-202).

Cnemidophorus tigris stejnegeri Van Denburgh (1894, p. 300) replaces *C. tesselatus stejnegeri (auct.; e. g.*, Smith, 1946, p. 426-428, pl. 120).

*Type locality "Valley of the Great Salt Lake, Utah".

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The Subspecies of the Plains Garter Snake, *Thamnophis radix*

Albert G. Smith

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Howard K. Gloyd, Director.

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Bulletin of the Chicago Academy of Sciences

The Subspecies of the Plains Garter Snake, *Thamnophis radix*

Albert G. Smith*

The garter snake, *Thamnophis radix* (Baird and Girard), ranges from the Wyoming Basin eastward through the Great Plains into the eastern part of the Central Lowlands. Such a widely distributed species naturally exhibits considerable variation. Earlier workers described three "color forms" under names which Cope (1900) synonymized with *radix* since, in his opinion at that time, they were not sufficiently different to deserve distinction as subspecies. These were *Eutaenia haydenii* Kennicott (1860), South Dakota; *Eutaenia radix twiningii* Coues and Yarrow (1878), Montana; and *Eutaenia radix melanotaenia* Cope (1888), Indiana. Cope also described *E. butleri* (1889), Indiana, and *E. brachystoma* (1892), Pennsylvania, which have been regarded as separate species by most authors during recent years, although their affinities with *radix* were recognized and Blanchard (1925) considered *butleri* a subspecies of *radix.*

My investigations of this group have led to the conclusion that the species *radix,* on the basis of morphological characters, is divisible into four subspecies: *Thamnophis radix radix, T. r. haydenii, T. r. butleri,* and *T. r. brachystoma.* The name *haydenii* is applied to the western subspecies.

Thamnophis radix haydenii (Kennicott)

Eutaenia haydenii, 1860, KENNICOTT, Rep. U. S. Pac. R. R. Surv., vol. 12, book 2, pt. 3, no. 4, p. 298, pl. 14.

Eutaenia radix twiningii, 1878, COUES AND YARROW, Bull. U. S. Geol. Surv. Terr., vol. 4, art. 11, p. 279-280.

Type Specimen. U.S. National Museum 707, collected by Dr. Evans (?) at Fort Pierre in Nebraska. This locality is now in Stanley County, South Dakota.

*Contribution of the Department of Biological Sciences, Loyola University, Chicago.

Original Description. "Sp. ch.—Head broader and more depressed in front than in *E. radix.* Form stout, compact, and cylindrical, most so of the genus, except *E. radix.* Ground color light olive green, with three longitudinal yellow stripes, and six series of distinct black spots. In life some red coloring visible on the sides. Lateral stripe on third and fourth rows less sharply defined than in *E. radix.* Dorsal rows, 21."

Taxonomic History. Cope (1900, p. 1089) considered both *haydenii* and *twiningii* as color variants, and synonymized these names under *radix.* Ruthven (1908, p. 70) followed Cope in this procedure but commented on the higher number of ventrals in western specimens. The subspecies *twiningii* of Coues and Yarrow is not sufficiently distinct from *haydenii* to be recognized separately, but in all characters falls within the expected range of the characters of *haydenii.*

Lectotypes. The condition of the original type is such that no complete examination can be made of it. At my request, both Dr. Doris M. Cochran and Dr. H. K. Gloyd separately examined the type, but could not get any definitive counts or measurements. Dr. Gloyd informed me that the specimen is falling apart and Dr. Cochran, after detailing in a letter the mutilated condition of the type, suggested that a lectotype be designated. Accordingly the following series of specimens from South Dakota in the Chicago Academy of Sciences, all collected by H. K. Gloyd and T. I. Wright from areas near the type locality, are designated as "paralectotypes":

14498, Whitlock Crossing, Dewey County
14499, 6 miles west of Thatcher, Dewey County
14500, La Plant, Dewey County
13858, 3 miles southeast of Emory, McCook County.

Through the courtesy of the Chicago Academy of Sciences, numbers 14498-9 have been sent as a gift to the United States National Museum and 14498 may be considered as the lectotype.

Color. There are three stripes on a light brownish olive ground color. Anteriorly, the lateral stripe occupies the whole of the third and fourth row of scales on each side, narrowing posteriorly to the third and a small portion of the fourth row. In life this stripe is grayish, slightly tinted with yellow. The dorsal stripe occupies the vertebral (11th) row and one-half of each adjacent scale row; it is orange-yellow in life. Two parietal spots, one on each side of the parietal suture, are present, each of a slightly lighter shade than the dorsal stripe. There are two rows of dark chestnut-brown blotches, alternating with each other between the dorsal and lateral stripes. These blotches are largest anteriorly, being three scales high by one and one-half scales wide. Another row of chestnut-brown spots is present between the lateral stripes and

the ventral scales. The color of the belly varies from an unspotted whitish chin and neck to a slightly greenish color posteriorly. There is a series of small black elongated crescents on the lateral edges of the ventrals, mostly on the posterior half of the body. The under surface of the tail is heavily mottled with black.

Variation. A series of 794 specimens has been examined from all parts of the range; of these 393 were adult males and 80 were juvenile males, and 271 were adult females and 50 were juvenile females. The variable characters of this and the following subspecies have been analyzed statistically, and it is planned to present these analyses in a subsequent paper on the *radix* group of *Thamnophis.*

The dorsal scales are arranged in 21-21-19-17 rows in 520 (78.4 per cent) specimens; in 19-21-19-17 rows in 132 (20 per cent); and in 23-21-19-17 rows in 11 (1.7 per cent) (see Table I). No specimens of *haydenii* were found to have a pattern of 19-19-17, the arrangement typical of *butleri.*

The ventrals in 300 males vary from 140 to 175 (mean 162) and in 245 females from 139 to 174 (mean 157). The greater number of specimens (85 per cent) have a higher number of ventrals than the mean (154) of *radix* (see Table II). The subcaudals of 275 males range from 69 to 88 (mean 78), and of 233 females from 58 to 74 (mean 67). The mean subcaudal count of *radix* is 75 in males and 65 in females.

The upper labial scales number seven on each side, although eight scales on each side are found in 40 per cent of the specimens; the lower labials number nine on each side, although 10 lower labials are found more frequently (25 per cent) in *haydenii* than in *radix* (11 per cent).

The tail/total length ratio of the 275 males varied from .205 to .278 per cent (mean .253), and of 233 females from .205 to .275 per cent (mean .232). The largest male examined was UMMZ 76521 [3rd] from near Kaodka, Jackson County, South Dakota, which measured 853 mm. in total length, tail length, 192 mm. The largest female, UMMZ 55644, from Lake Okoboji, Dickinson County, Iowa, measured 1045 mm. in total length, tail length 213 mm.

The dorsal blotches between the stripes average 93 in *haydenii* while in *radix* the average number is 84. The blotches are largest anteriorly in both subspecies, in *haydenii* normally three scales high by one and one-half wide, in *radix* from one-half to one scale larger in each direction.

The color of the dorsal stripe in both subspecies is variable, although generally the dorsal stripe is more orange-yellowish in *haydenii.* No real color differences in the lateral stripes are noticeable. Some Oklahoma specimens of *haydenii* exhibit a temporal crescent similar to that of *marcianus,* although it is not as well defined.

TABLE I

Variation in Scale Rows in the Subspecies of *Thamnophis radix* Expressed as a Percentage of the Total Number of Each Subspecies.

Number of scale rows	*haydemi*	*radix*	*butleri*	*brachystoma*
17-17-15	——	——	00.03	99.75
17-19-17	——	——	00.29	00.21
19-19-17	——	22.10	99.68	00.04
19-21-19-17	19.90	76.00	——	——
21-21-19-17	78.40	1.77	——	——
23-21-19-17	1.70	0.13	——	——

TABLE II

Variation in the Ventral and Subcaudal Scales and the Tail/Total Length Ratio in the Subspecies of *Thamnophis radix*.

	Males			*Females*		
	No.	Extremes	Mean	No.	Extremes	Mean
VENTRALS						
haydenii	300	140-175	162.1	245	139-174	157.2
radix	423	138-175	157	436	135-174	151
butleri	124	132-147	140.4	104	129-147	137.9
brachystoma	117	134-146	140	107	132-146	139
SUBCAUDALS						
haydenii	275	69-88	78	233	58-74	67
radix	421	67-88	75	400	54-74	65
butleri	106	57-71	64	97	51-63	56
brachystoma	103	57-72	67	98	51-64	59
TAIL/TOTAL LENGTH RATIO						
haydenii	275	.205-.278	.253	233	.205-.275	.232
radix	230	.207-.275	.235	211	.176-.247	.214
butleri	106	.215-.282	.248	97	.193-.244	.216
brachystoma	103	.207-.282	.252	98	.198-.246	.227

Range. *Thamnophis radix haydenii* occurs in the Great Plains from Minnesota south through western Iowa, Kansas, and the Oklahoma Panhandle, west into the foothills of the Rocky Mountains, and north into the southern portion of the Plains of Canada (Fig. 1, p. 291).

*Material Examined.** (Names of counties in *italics*)

CANADA. ALBERTA: Richdale, ROMZ 2396-7, 2502; Richmond, ROMZ 2500; Rose Lynn, ROMZ 2501; Veteran, ROMZ 1459. MANITOBA: Winnipeg, ROMZ 2607; Lake Winnipeg, USNM 9251. SASKATCHEWAN: Indian Head, ROMZ 4442; Lumsden Beach, ROMZ 3213-4; Melville, ROMZ 3175-6; Regina, USNM 22404.

COLORADO: *Arapahoe*—Deertrail, UMMZ 67402, 67436; Englewood, UMMZ 43878. *Boulder*—Boulder, AMNH 17287. *Denver*—Denver, USNM 15794. *El Paso*—Colorado Springs, AMNH 4219-20, 4239, 66542-3, 68709-13; Valmont, AMNH 4215, 4221-35, 4249. *Fremont*—Canon City, CA 904. *Larimer*—Fort Collins, UMMZ 46590-7. *Prowers*—Lamar, UMMZ 62441-3. *Pueblo*—Pueblo, USNM 8581. *Weld*—Laird, CNHM 38122,

IOWA: *Adair*—Greenfield, RMB. *Audubon*—Brayton, ISC 69; Kimballton, RMB. *Boone*—Pilot Mound, UMMZ 92947. *Buena Vista*—Alta, Newell, RMB. *Calhoun*—Twin Lake, UMMZ.† *Carroll*—Swan Lake State Park, ISC 824. *Cass*—Lyman, ISC 694; Atlantic, UMMZ 92953, 12964. *Cherokee*—Holstein, UMMZ 92959. *Clay*—Lost Island Lake, UMMZ 35093-4, 35098-121; Spencer, UMMZ 92956, 35132-3, 35172; Webb, UMMZ 35175, 35178. *Crawford*—Vail, RMB. *Dallas*—Minburn, UMMZ 92948. *Dickinson*—Arnold Peak, CNHM 35509; Center Grove Twp., UMMZ 55175, 55180, 55639, 55641-2; Lake Okoboji, CM 21702-3, UMMZ 55648-54, 55657-8, 55660, 89661; Milford, UMMZ 55163-74, 55176-9; Spirit Lake, UMMZ 55666-7, 92938-9, 92949. *Emmett*—Dolliver, UMMZ 92950. *Fremont*—Bartlett, ISC 717. *Greene*—Boxholm, ISC 767; Jefferson, RMB. *Guthrie*—Bagley, RMB. *Harrison*—Yorkshire, ISC 709. *Humboldt*—Humboldt, UMMZ 60166. *Ida*—Holstein, RMB. *Kossuth*—Lakota, RMB. *Lucas*—Chariton, UMMZ 92962. *Mills*—Council Bluffs, ISC 721-2. *Monona*—Onawa, UMMZ 92966. *Montgomery*—Grant, RMB. *O'Brien*—Calumet, UMMZ 92954. *Osceola*—Rush Lake, CM 21694. *Palo Alto*—Ruthven, UMMZ 35154-75, 31376. *Plymouth*—Hinton, ISC 699. *Pocahontas*—Fonda, RMB. *Polk*—Des Moines, USNM 14761, 45586. *Pottawattamie*—Council Bluffs, RMB. *Sac*—Lake View, RMB. *Shelby*—Harlan, RMB. *Union*—Creston, RMB. *Wayne*—Corydon, ISC 723. *Webster*—ISC 712. *Woodbury*—Luton, UMMZ 92946; Sloan, UMMZ 60167 (5). *Wright*—Solberg, RMB.

*The following abbreviations are used in the text to designate collections: AGS, Albert G. Smith; AMNH, American Museum of Natural History; ANSP, Academy of Natural Sciences, Philadelphia; CA, Chicago Academy of Sciences; CM, Carnegie Museum; CNHM, Chicago Natural History Museum; ISC, Iowa State College; KU, University of Kansas Museum; MMNH, Minnesota Museum of Natural History; MPM, Milwaukee Public Museum; OSM, Ohio State Museum; UMMZ, University of Michigan Museum of Zoology; UOMZ, University of Oklahoma Museum of Zoölogy; USNM, United States National Museum; RMB, Reeve M. Bailey; ROMZ, Royal Ontario Museum of Zoölogy.

†A series of 27, not catalogued when examined.

KANSAS *Barton*—UMMZ 67037 *Cheyenne*—St Francis, USNM 86916, KU 20303, 20918 23 *Cloud*—KU 2043 *Coffey*—Winfield, USNM 90572, Neosho River, KU 1997 2028, 2031, 2044 7 *Dickinson*—Herington, USNM 90571 *Douglas*—KU 2103 4, 2129 15499, 17416 18498, 18500 8, 19607, Haskell Bottoms, KU 17418, Haskell Institute, KU 2010, Kansas University Campus, KU 2077 8, 2086, Lawrence, KU 2027, 2029 2058, 7358, 19288 291, 19605-6, 20004 *Finney*—Holcomb, USNM 86927 *Franklin*—CM 8668, 8684, CNHM 18148 50, UMMZ 67038, Wellsville, USNM 89180 *Geary*—Fort Riley, USNM 5486 *Gove*—KU 2100 *Gray*—Ingalls, KU 21425 *Hamilton*—Coolidge, KU 20316 *Harper*—Harper, KU 17903, Hunter KU 3052 *Harvey*—Halstead, KU 2041 *Kearny*—Deerfield, USNM 86926 *Kingman*—Norwich KU 17918 *Lane*—Pendennis, KU 3612 4 (5), 3721 *Logan*—Vincent Ranch, KU 20311 *Marion*—Lincolnville, KU 23602 *Marshall*—Irving, CNHM 18153 *McPherson*—USNM 89178 *Meade*—Meade, AMNH 62846 7, KU 5436, 5440, 5442-3, Meade State Park, UMMZ 88486, 91526, KU 21861 *Morton*—Spring Creek, KU 2567 77, Elkhart, KU 3566-7, 3611, 5437 9, 5444-5 *Osborne*—KU 2082 4 *Rawlins*—McDonald, KU 2034, 14135 *Republic*—KU 2126 *Rice*—UMMZ 67375 *Riley*—Manhattan, USNM 89179, AMNH 36893 *Rooks*—KU 2105 *Russell*—KU 2023, Republican River, USNM 655 *Scott*—Scott County State Park, UMMZ 75629 *Sherman*—Goodland, KU 20292-5 *Stafford*—Little Salt Marsh, UMMZ 67373, USNM 73332, KU 2025, 3609 *Thomas*—Rexford, UMMZ 67374 *Trego*—KU 1995, 2081, 2094, 2098, 2699, 3700, USNM 56270, Collyer, KU 3610 *Wallace*—KU 2011, Rhino Hill Quarry, KU 14134, 15697, 17170 1, Sharon Springs, KU 14136

MINNESOTA *Anoka*—MMNH 809; Johnsville, MMNH 890 *Brown*—Sleepy Eye, MMNH 147 *Clay*—Barnesville, MMNH 844, Hitterdal, MMNH 551; Syre, MMNH 552 *Clearwater*—Itasca State Park, CM 20529 *Cottonwood*—Des Moines River, MMNH 940 *Dakota*—Rosemont, MMNH 874 *Faribault*—Aldemn, MMNH 819 *Fillmore*—MMNH 816 *Hennepin*—MMNH 344 5, Minneapolis, AMNH 64608, 3260, 3262; Fort Snelling, USNM 32048-50 *Jackson*—Heron Lake, MMNH 148, 942 3 *Mahnomen*—Waubun, CM 20588 *Nicollet*—Swan Lake, MMNH 937 *Ramsey*—St Paul, MMNH 319 *Rice*—Faribault, MMNH 323 *Scott*—Jordan, MMNH 757 *Sherburne*—Elk River, MMNH 998 *Steele*—Owatonna, MMNH 857 *Yellow Medicine*—MMNH 963; Granite Falls, MMNH 954

MONTANA *Carter*—Alzada, UMMZ 92788 (3), Capitol, USNM 54725 *Cascade*—Cascade, CA 3608, Great Falls, USNM 44228 *Chouteau*—Fort Benton, USNM 712 *Custer*—Miles City, USNM 61621, UMMZ 46568, 76495, 92787 *Dawson*—Jordan, UMMZ 49820, Glendive, USNM 54443 *Prairie*—Terry, USNM 61618 *Valley*—Glasgow, USNM 62531 The following localities are not exactly placeable Frenchman's Creek, USNM 9540-1, Milk River, USNM 698, 714, 716; Mouse River, USNM 9531 Yellowstone River, USNM 703-4, 711, 11478

NEBRASKA *Antelope*—Brunswick, UMMZ 67403 *Brown*—Ainsworth, CNHM 19237; Long Pine, AMNH 4929. *Buffalo*—Fort Kearney, USNM 658, 665, 45584 *Cherry*—Kennedy, USNM 44298; Merriman, AMNH 37058 *Dakota*—Jackson, UMMZ 67404 *Dawes*—Chadron, USNM 21270 *Lincoln*—Forks of Platte River, USNM 21537 *Merrick*—Central City, USNM 118451-2 *Pierce*—Hadar, USNM 83965 *Scotts Bluff*—Morrill, UMMZ 71662 *Sheridan*—Lakeside, UMMZ 71661; Antioch, UMMZ 79700, Ellsworth, UMMZ 71663; Gordon, AMNH 36804. *Sherman*—Loup City, UMMZ 3703 *Thayer*—Hebron, AMNH 36736-7 *Valley*—Ord, AMNH 36734 The following are

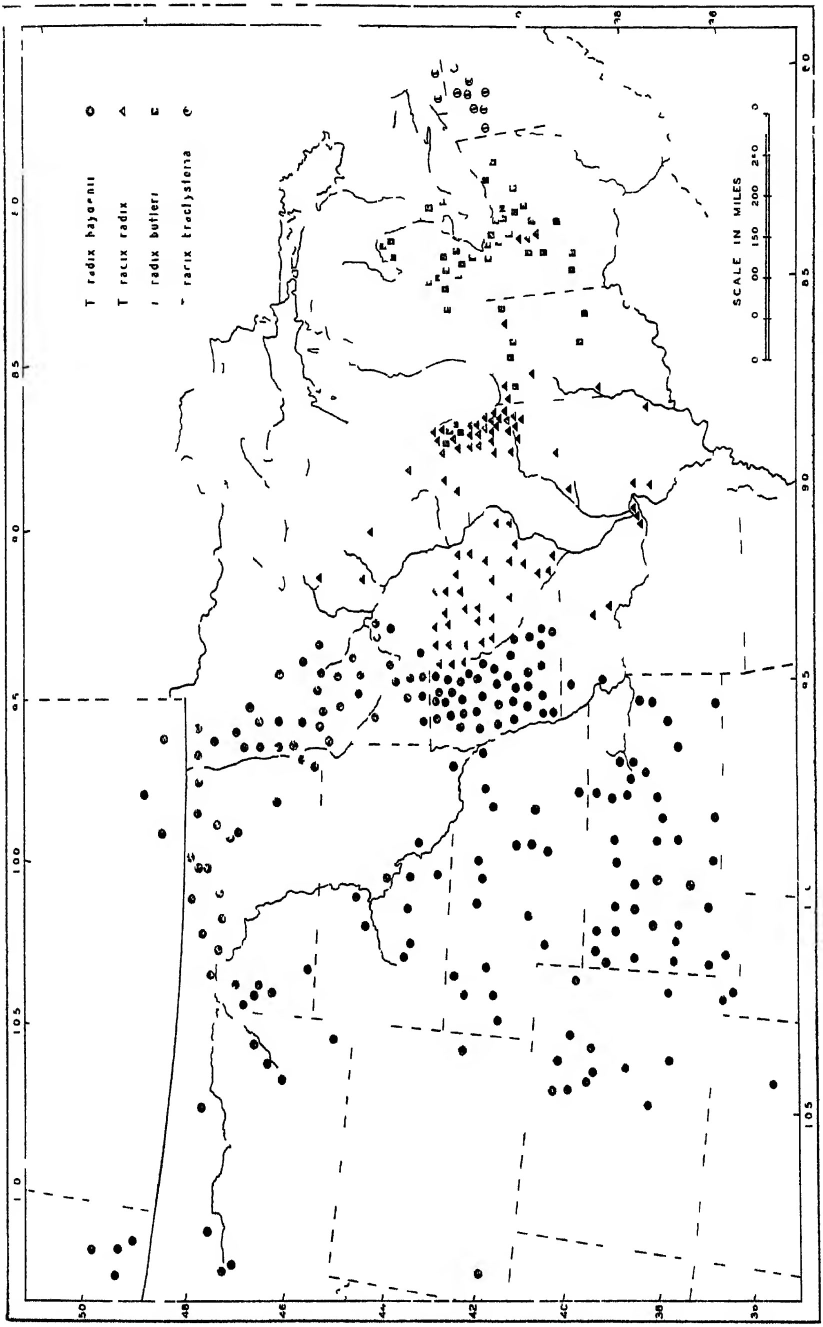

Figure 1. Geographic distribution of the subspecies of *Thamnophis radix*. Based on specimens examined by the writer.

not exactly placeable: Platte River, USNM 650, 660, 662, 666; South Platte River, USNM 612.

NEW MEXICO: *Mora*—Fort Union, USNM 86921-5. *San Miguel*—Las Vegas, UOMZ 25224-7.

NORTH DAKOTA: *Adams*—Hettinger, UMMZ 65061. *Barnes*—Valley City, USNM 66616. *Benson*—Spring Lake, USNM 53072. *Billings*—Medora, UMMZ 54465, 56906-9 *Bottineau*—Bottineau, UMMZ 53803-5. *Cavalier*—Langdon, UMMZ 90202 *Eddy*—Warwick, UMMZ 54469. *Grand Forks*—Larimore, USNM 53037. *McHenry*—Towner, USNM 53036. *McKenzie*—Goodall, USNM 53038; Junction of Missouri and Yellowstone Rivers, USNM 695, 700, 710. *Mountrail*—Lostwood, USNM 53073. *Nelson*—Stump Lake, UMMZ 54467-8, 54471-2 *Pembina*—Pembina, USNM 9528-30, 9535-6. *Ramsey*—Devil's Lake, USNM 38082-3, 54466. *Richland*—Hankinson, USNM 49601; Wahpeton, USNM 53030. *Rollete*—Fish Lake, USNM 49589; Lake Upsilon, UMMZ 54470. *Ward*—Kenmare, USNM 50002. *Williams*—Buford, UMMZ 65289-90; Grinnell, USNM 53033-4.

OKLAHOMA: *Cimarron*—Cimarron, UMMZ 77562; Black Mesa, near Kenton, UOMZ 4930, 4937, 4941, 4943-4, 4947, 4950-3, 5140-9, 5170-3, 5233-8; State Monument, UMMZ 63517. *Texas*—Coldwater Creek, UOMZ 4842.

SOUTH DAKOTA: *Brule*—Pukwana, AMNH 36802-3. *Clay*—Vermilion, UMMZ 44692. *Dewey*—Thatcher, CA 14499; LaPlant, CA 14500; Whitlock Crossing, CA 14498. *Hughes*—Fort Pierre, USNM 707 (Type). *Jackson*—Kadoka, UMMZ 76519-28 (25); Belvidere, UMMZ 71678. *Jones*—Draper, AMNH 36805. *Lyman*—Reliance, AMNH 36782-9, CM 5145-6. *McCook*—Emory, CA 13858. *Tripp*—Dog Ear Lake, UMMZ 78118.

WYOMING: *Goshen*—Rawhide Butte, CNHM 1893. *Lincoln*—Jackson, UMMZ 65273 (2).

Thamnophis radix radix (Baird and Girard)

Eutaenia radix, 1853, BAIRD AND GIRARD, Cat. North Amer. Reptiles, pt. I, Serpents, p. 34.

Eutaenia radix melanotaenia, 1888, COPE, Proc. U. S. Nat. Mus., vol. 11, p. 400.

Thamnophis radix, 1899, JORDAN, Manual Vert. Animals, North Amer., 8th ed., p. 193; 1908, RUTHVEN, Bull. U. S. Nat. Mus., no. 61, p. 70.

Thamnophis radix radix, 1925, BLANCHARD, Papers Michigan Acad. Science, Arts and Letters, vol. 4, (1924), pt. 2, p. 18.

Diagnosis. A garter snake with 19 scale rows at the neck and 21 at midbody, and in which the ventral scales are usually 154 or less in number.

Type Specimen. United States National Museum 719, taken at Racine County, Wisconsin, by Dr. P. R. Hoy.

Description. The ground color varies from dark olive to dark brown. One dorsal and two lateral stripes are present; the lateral stripes are on the third and fourth scale rows, and the dorsal occupies the vertebral and one-half of each adjacent scale row. There are two rows of alternating blotches, larger than those of *haydenii* but not as numerous, between the lateral and dorsal

stripes; and another row of blotches on each side between the lateral stripes and the ventral scales. Parietal spots are usually present.

The scales are normally arranged in a pattern of 19-21-19-17 rows (76 per cent, Table I). Some Illinois specimens exhibit an arrangement of 19-19-17 rows, the typical pattern of *butleri*. Twelve of 860 specimens have 23 scale rows at the neck.

The ventrals in 423 males vary from 138 to 175 (mean 157), and in 436 females from 135 to 174 (mean 151). In 421 males the subcaudals range from 67 to 83 (mean 75), and in 400 females from 54 to 74 (mean 65).

The upper labials are seven on each side, and there are normally nine lower labials. Specimens with eight or seven-eight upper labials, and some with ten lower labials are frequently found. Seventeen have 10-11 lower labials and one has 11 lower labials on each side. Preoculars are one on each side, and the postoculars are three on each side. The temporal scales are normally 1—2 - 3, but a formula of 1—2—2 or of 1—1—2 is frequently found.

The tail/total length ratio in 230 males ranged from .207 to .279 (mean .235), and in 211 females from .176 to .247 (mean .214). The largest male, CNHM 2107, from Miller, Lake County, Indiana, measured 745 mm. in total length, tail length 170 mm. The largest female, CA 8031, from Sumner, Chariton County, Missouri, measured 845 mm. in total length, tail length 170 mm.

Definite intergrades between *radix* and *haydenii* have been seen from areas adjacent to the Des Moines River in Iowa. It is probable that intergradation occurs in northern Minnesota also. The various characters of scutellation in the eastern part of the range of *haydenii* grade into those of *radix*.

Range. This subspecies occurs in the Prairie Peninsula and its "islands" in Indiana and Ohio, and from Wisconsin south through Illinois and eastern Iowa into Missouri (Fig. 1, p. 291). Its distribution seems correlated mostly with the young and submature till plains, and it invades the older plateaus only on the periphery of its range.

Material Examined. (Names of counties in *italics*)

ILLINOIS: *Cook*—Argo, CNHM 3317, 21801; Berwyn, CNHM 776, 1440, 2126, 2699; Blue Island, CNHM 16066-7, 30420; Braeside, CNHM 15679, 15704, 16055; Chicago CA 1424-30, 1849, 4309, 4405, 7753-70, 7771, 7775-96, CNHM 90, 497, 536, 1435-8, 1444, 2438, 2962, 8281, 3092, 3330, 16068-71, 17034-9, 17611-4, 17633-42, 11213-4, 11216-20, 3058, 22668-70, 29421-2, 31506-20, 26020-30, 29410, 29418, 28260-9, 33892, 39392, 38033; Deerfield, CNHM 17703-5, 33880, 31942; Dunning, CA 11020-57; Edgebrook, CA 911; Evanston, CNHM 26301, 38032; Flossmoor, OSM 527, 632-3; Forest Park, CNHM 3091; Highland Park, CNHM 26302; Homewood, CNHM 8059, 8289, 8469, 8747, 8935, 6418, 6453, 6906, 7792-3, 7826-34, 16053-4, 22858, 22903, 21747-54, 31764-7,

28294; Kenilworth, CNHM 641; La Grange, CNHM 25981; Melrose Park, CA 7749-52; Pullman, CNHM 1931; Riverdale, CNHM 648; River Forest, CNHM 25438, 16059-65, 3343, 3248, 21817-8; Schiller Park Forest Preserve, CA 6884-5; Summit CNHM 21256-7; Wolf Lake CNHM 15563-4. *DeKalb*—Sycamore, UMMZ 46589. *DuPage*—Bensenville, CA 6052-78; DuPage River, CNHM 7450; Glen Ellyn, UMMZ 46564-74, 46569; Hinsdale, CNHM 37214, 29132-8; Lombard, CNHM 3331, 21812-4 35485, 3286-7; Naperville, CNHM 19936, 19938, 22050-2, 25979-80, 26301-2, 26303-5, 33702-6; Villa Beach, CA 1420-3; Warrensville, CNHM 38701; West Chicago, CA 2032-3; Wooddale CNHM 29419, 35760, 35316. *Grundy*—Diamond, CNHM 35974. *Kankakee*—Pembroke Township, CA 2589. *Lake*—Barrington, CNHM 23001-5; Beach, CA 1367-70; Briggs Lake, CA 6189; Fox Lake, CNHM 1896; Grass Lake, CA 1803; Lake Zurich, CA 6620; Volo, CA 1836; Waukegan CNHM 2436; Winnetka, CNHM 22596-635; Wooster, CA 7646; Wooster Lake, CA 7636-45. *LaSalle*—Starved Rock State Park, CA 6028-9. *Madison*—UMMZ 46469, 46575, 46588. *McHenry*—CNHM 29201-25, 29278-80, 28206, 29227-41, 29332-63, 29428-32; Richmond, CNHM 17976-7. *McLean*—Bloomington, CA 2524-5, UMMZ 27475-6. *Rock Island*—Moline, UMMZ 79225. *St. Charles*—UMMZ 46583-6. *Wabash*—Mt. Carmel, USNM 12035. *Will*—New Lenox, CA 4310, CNHM 2817; Wheatland Township, CNHM 7455.

INDIANA: *Lake*—Hesseville, CNHM 4103, 21712; Miller, CNHM 2107; Illinois, CNHM 3355. *Noble*—Wolf Lake, CNHM 21746. *Porter*—Valparaiso, CA 994. *Vigo*—Honey Creek, USNM 25951. *White*—0.2 mi. s. of White-Pulaski Co. line on Hwy. 43, Collection of S. A. Minton, Jr.

IOWA: *Benton*—Blairstown, ISC 693. *Bremer*—Waverly, Frederika, Sumner, RMB. *Butler*—Dumont, ISC 715; Shell Rock, ISC 815. *Cerro Gordo*—Ventura, ISC 669. *Chickasaw*—Lawler, RMB. *Clayton*—Strawberry Point, UMMZ 92963. *Delaware*—Manchester, RMB. *Fayette*—west of Strawberry Point, ISC 708. *Floyd*—Charles City, UMMZ 92945 (2). *Grundy*—Dike, RMB. *Hamilton*—Stratford, UMMZ 92952. *Hancock*—Forest City, UMMZ 92995. *Hardin*—Hubbard, ISC 697. *Howard*—Lime Spring, UMMZ 92958. *Jefferson*—Fairfield, UMMZ 92961. *Johnson*—Iowa City, ISC 4756. *Lee*—Keokuk, ISC 292. *Linn*—Cedar Rapids, Coe College. *Marshall*—State Center, ISC 720 *Muscatine* Nichols, RMB. *Poweshiek* - Grinnell, ISC 710. *Scott*—Davenport, RMB. *Story*—Ames, UMMZ 92940 (20). 92941 (30), 92942 (25), 92943 (36). *Tama*—Tama, RMB. *Washington*—West Chester, ISC 700. *Worth*—Joice, UMMZ 92944 (2). *Wright*—Solburg, RMB.

MISSOURI: *Buchanan*—St. Joseph, UMMZ 56597. *Chariton*—Sumner. CA 8013, 8028-9, 8031. *Nodaway*—Maryville, CA 8015-7. *St. Charles*—Boschertown, CA 8024-5, 8032-3; Elm Point, CA 8030; Orchard Farm, CA 8014, 8018; St. Peter's, CA 5109-38, 8026-7, UMMZ 46467-8, 46576, 46581-2, 46587, 46599. *St. Louis*—USNM 18814.

OHIO: *Marion*—OSM 535-9; Greencamp Township, OSM 671. *Wyandot*—Pitt, Township, OSM 667, 670.

WISCONSIN: *Dane*—Madison, USNM 17423, CNHM 37844; Lake Monona, CNHM 42669. *Green*—New Glarus, UMMZ 64747-8. *Green Lake*—Green Lake, CA 6657. *Kenosha*—New Munster, CA 5453-61; Kenosha, USNM 17416-7. *Milwaukee*—MPM 552, 2518. *Racine*—USNM 719 (Type); Racine, USNM 1044 (11); Corliss, MPM 1505, 1508, 1501, 1503, 1516, 1494, 1499. *Walworth*—Lake Geneva, CA 5079-80; Pell Lake, CNHM 30552.

THE BUTLERI—BRACHYSTOMA COMPLEX

Although Ruthven (1908) accorded *butleri* specific status within the genus, Blanchard (1925, p. 18) regarded it as a subspecies of *radix* in his key. Dr. H. K. Gloyd has checked those notes of Blanchard which are in his possession but can find no information which would indicate the basis for this taxonomic change. Davis (1932, p. 113-118), after a study of the Wisconsin population, regarded *butleri* as a distinct species. Later, in resurrecting *brachystoma,* Smith (1945, p. 147-149) continued to regard *butleri* as a distinct species, as well as *brachystoma*. It now seems necessary to reconsider the status of these two forms, particularly as they relate to the other subspecies, *radix* and *haydenii*.

Scale Rows. Of 237 specimens of *butleri* available, the dorsal scales are arranged in 19-19-17 rows in 228. Four Ohio and three Michigan specimens have 17-19-17 rows; one Ohio specimen has 19-19-17 rows and one Michigan specimen has 17-17-15 rows. The dorsal scales are arranged in 17-17-15 rows in 216 of the 221 specimens of *brachystoma* available; four Pennsylvania specimens having 17-19-17 rows, and one New York specimen 19-19-17 rows. The dorsal scales of 192 (28.5 per cent) of 674 eastern Illinois specimens of *radix* are arranged in 19-19-17 rows. It seems then that in number of scale rows *radix* grades into *butleri,* and there is not a sufficient break in the number of scale rows to warrant full specific rank for *butleri* on this character alone. Although the scale rows are greatly reduced in *brachystoma,* the slight tendency to the higher number of *butleri* is significant, and if sufficient specimens were available, particularly from the eastern Ohio region, the gradual reduction in scale rows between *butleri* and *brachystoma* might be demonstrable.

Ventral Scales. The range of ventrals in 228 specimens of *butleri* is from 129 to 147, mean 139.1 (132-147, mean 140.4, in 124 males, and 129-147, mean 137.9 in 102 females). In 224 specimens of *brachystoma* the ventrals vary from 132 to 146, mean 139.5 (134-146, mean 140, in 117 males, and 132-146, mean 139, in 107 females). There does not seem to be any basis in this character with which to separate *butleri* from *brachystoma.* There are 225 specimens of *radix* from eastern Illinois which have the ventral or subcaudal counts of *butleri,* so that the intergradation of the two forms in these characters seems to be established.

Subcaudal Scales. This is the least indicative character on which to separate either *radix, butleri,* or *brachystoma* from each other.

Color. Although more investigation is needed, the change in pattern and color is suggestive of a west to east gradient. The color of the vertebral stripe tends to lessen from the orange-yellowish color of *haydenii* to the very

light-yellowish color of *brachystoma.* The dorsal inter-stripe blotches diminish numerically from *haydenii* to *radix,* and from *radix* to *butleri;* they are reduced both in number and in size. The blotches as such have disappeared in *brachystoma,* in which rarely they coalesce to form a border along the stripes. The ground color also becomes much darker in both *butleri* and *brachystoma*, and in both of these the lateral stripe begins to involve a portion of the second scale row. Consideration of all characters seems to justify the conclusion that *butleri* and *brachystoma* are only partially distinct from each other.

There are specimens of *radix* from eastern Illinois in which various taxonomic characters grade into those associated with *butleri.* There are also 12 specimens of *radix* from this same area in which all characters are so close to those of *butleri* that they might be considered valid *butleri.* This evidence indicates that *butleri* is not sufficiently distinct from *radix* to merit specific rank, and that both *butleri* and *brachystoma* should be considered subspecies of *radix.*

Thamnophis radix butleri (Cope)

Eutaenia butleri, 1889, COPE, Proc. U. S. Nat. Mus., vol. 17, p. 399.

Thamnophis butleri. 1908, RUTHVEN, Bull. U. S. Nat. Mus., no. 61, p. 87; 1932, DAVIS, Copeia, no. 3, p. 113; 1945, SMITH, Proc. Biol. Soc. Washington, vol. 58, p. 147.

Thamnophis radix butleri, 1925, BLANCHARD, Papers, Michigan Acad. Science, Arts, and Letters, vol. 4 (1924), pt. 2, p. 18.

Diagnosis. A garter snake with 19 scales at the neck and midbody, and 17 anterior to the anus; the head is distinct from the neck; the dorsal inter-stripe blotches are reduced numerically and in size. The ventral scales vary from 132 to 147 (mean 140.4) in males, and from 129 to 147 (mean 137.9) in females; the subcaudal scales vary from 57 to 71 (mean 64) in males, and from 51 to 63 (mean 56) in females (see Tables I and II).

Range. This subspecies occurs in glaciated territory in southeastern Wisconsin, Indiana, the eastern half of the lower peninsula of Michigan, Ohio, and southwestern Ontario (Fig. 1, p. 291). So far as known, *T. r. butleri* does not occur in Prairie Peninsula habitats.

In the opinion of the writer, the discontinuity in the geographic range of *butleri,* which has occasioned comment by recent authors, is more apparent than real. This is substantiated by consideration of the following facts: (a) of 674 specimens examined from the intermediate region (Chicago area), 449 are definitely *radix;* (b) of the remaining 225, some have either the scale row count of *butleri* or the ventral or caudal count of *butleri* but in other characteristics are similar to *radix;* (c) of these 225, only 12 are morphologically close enough to *butleri* to be considered *butleri.* These considerations, together with the low number (12) of seemingly valid *butleri* from the Chicago region,

suggest that—taxonomically—it would be better for the present to consider the Chicago region population as *radix* rather than as *radix* x *butleri*. The figures given above show the numerical prevalence of *radix* in the Chicago region and that the population is in a differentiating condition. The scarcity of specimens of *butleri* from Wisconsin may indicate that *butleri* is gradually being replaced by *radix* in that area, as Davis (1932, p. 116) thought must have happened in the Chicago region.

Thamnophis radix brachystoma (Cope)

Eutaenia brachystoma, 1892, COPE, Amer. Nat., vol. 26, p. 964.
Thamnophis brachystoma, 1945, SMITH, Proc. Biol. Soc. Washington, vol. 58, p. 149.

Diagnosis. A garter snake in which the dorsal scales are reduced to 17 rows throughout; the head is not distinct from the neck; and the dorsal interstripe blotches are greatly reduced or absent. The ventral scales vary from 134 to 146 (mean 140) in males, and from 132 to 146 (mean 139) in females. The subcaudal scales vary from 57 to 72 (mean 67) in males, and from 51 to 64 (mean 59) in females (see Tables I and II).

Range. This subspecies occurs in a restricted area within the upper Allegheny River drainage pattern in southwestern New York and northwestern Pennsylvania (Fig. 1, p. 291).

DISCUSSION

It is generally conceded that glaciation has been a factor in the distribution and speciation of the herpetofauna of the northern midwestern area of the United States. Schmidt (1938, p. 401) postulates a *radix*-like form which occupied the central midwest (at least) during the preglacial or interglacial times. The action of the glacier would tend either to isolate or, more probably, to cause a southward migration of many indigenous forms.

The action of the glacier also not only partially but, in some cases, wholly changed the character of the climate, soil, and vegetation; it likewise caused the erection of barriers to the redistribution of many preglacial forms. The prairies which once extended to the Appalachian Mountain area (Fenneman, 1931, p. 616) changed, due to the glacial action, especially in the eastern section, where a prairie-forest transition zone resulted. Thus prairie habitats were isolated either as peninsulae or as islands (Transeau, 1935, p. 423-437). During this same postglacial period, the Great Lakes were formed, thus poising a very formidable barrier to the redistribution of many terrestrial poikilotherms. It seems reasonable to explain the diversity and variation of the various subspecies of *Thamnophis radix* as a result of glacial action.

During the glacial era, a *radix*-like form was probably driven southward and westward to a climatic situation more suitable to the survival of the species. This area was most probably a corner of the Kansas-Missouri-Oklahoma-Arkansas section. As glacial conditions changed to a warmer climate, this form began to reinvade its former range, only to meet a variously changed habitat.

The presumably older form, *Thamnophis radix haydenii,* maintained itself fairly close to the probable morphological character of the preglacial *radix.* However, as the reinvasion occurred, there was presented a transition in habitat from the higher and drier plains of the west to the moist prairies of the central region, thence into a prairie-forest transition, and finally forests themselves. In the Chicago area, the presence of Lake Michigan seems to have caused the reinvading form to diverge, one stem northward and the other eastward.

This is exemplified by the morphological closeness of *butleri* to *radix* in Wisconsin. This also seems to me to account for the rather spotty occurrence of *radix* to the east where it occurs in definite prairie islands (Conant *et. al.,* 1945, p. 61-68). It is probable that both the Wisconsin population of *butleri* and the eastern populations of *radix* are disappearing as their habitats in these areas undergo change.

The following key has been tested on 700 specimens, and can effectively separate about 85 per cent of those examined, if used with geographical data.

1	Lateral stripe on third and fourth scale rows, at least on the anterior half of the body	2
	Lateral stripe encroaching on the second scale row	3
2	Scale rows usually 21 at neck; ventrals generally 155 or more	*haydenii.*
	Scale rows usually 19 at neck; ventrals generally 154 or less	*radix.*
3	Scale rows 19 at neck and mid-body	*butleri.*
	Scale rows 17 at neck and mid-body	*brachystoma.*

SUMMARY

A western subspecies of *Thamnophis radix* Baird and Girard is described to which the name *haydenii* of Kennicott (1860) is applied. This western subspecies is characterized by a higher number of dorsal scales at the neck, and a higher number of ventral and subcaudal scales than are found in the central race, *Thamnophis radix radix.*

The two eastern races, *T. butleri* and *T. brachystoma,* until now regarded as separate species, are considered to be subspecies of *Thamnophis radix radix.* This systematic change is indicated by the presence of definite intergrading

specimens between *radix* and *butleri* and by the similarity of scutellation between *butleri* and *brachystoma.*

The diversity of characters and of size in the four subspecies is considered to be the result of the reinvasion of a habitat changed by glaciation.

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A Western Subspecies of *Bufo woodhousii* Hitherto Erroneously Associated with *Bufo compactilis*

Frederick A. Shannon

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The Bulletin of the Chicago Academy of Sciences was initiated in 1883 and volumes 1 to 4 were published prior to June, 1913. During the following twenty-year period it was not issued. Volumes 1, 2 and 4 contain technical or semi-technical papers on various subjects in the natural sciences. Volume 3 contains museum reports, descriptions of museum exhibits, and announcements.

Publication of the *Bulletin* was resumed in 1934 with volume 5. It is now regarded as an outlet for short to moderate-sized original papers on natural history, in its broad sense, by members of the museum staff, members of the Academy, and for papers by other authors which are based in considerable part upon the collections of the Academy. It is edited by the Director of the Academy with the assistance of a committee from the Board of Scientific Governors. The separate numbers are issued at irregular intervals and distributed to libraries, scientific organizations, and specialists with whom the Academy maintains exchanges. A reserve is set aside for future need as exchanges and the remainder of the edition offered for sale at a nominal price. When a sufficient number of pages have been printed to form a volume of convenient size, a title page, table of contents, and index are supplied to libraries and institutions which receive the entire series.

Howard K. Gloyd, Director.

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Bulletin of the Chicago Academy of Sciences

A Western Subspecies of *Bufo woodhousii* Hitherto Erroneously Associated with *Bufo compactilis**

Frederick A. Shannon

The name *Bufo speciosus* Girard was recently revived by Smith (1947) for the subspecies of *Bufo compactilis* Wiegmann occurring north of the Mexican border. A further investigation of the curious, isolated population of supposed *compactilis* occurring in Arizona, Utah, and Nevada was contemplated by Smith, who gathered together from various collections much of the material pertinent to the problem. The actual study was postponed as other duties intervened, however, and eventually, knowing my interest in both the area and in the specific problem, he turned the investigation over to me.

The purpose of this paper is to demonstrate (1) that the Arizona-Nevada-Utah toads, previously known as subspecies of *Bufo compactilis (B. c. speciosus)*, are actually subspecies of *Bufo woodhousii*, and that they should be known as *Bufo woodhousii microscaphus* Cope; (2) that the ranges of *Bufo woodhousii woodhousii* and *Bufo woodhousii microscaphus* are not overlapping, except in certain intergrading areas; and (3) to propose that *Bufo californicus* be allocated as another subspecies of *Bufo woodhousii* (i. e., *Bufo woodhousii californicus)*. It should be emphasized that no subspecies of *Bufo compactilis* is found in Arizona. *Bufo compactilis speciosus* approaches no closer than the southeastern corner of New Mexico.

Most of the material accumulated by Smith was from the U. S. National Museum, the University of Kansas, and the California Academy of Sciences. This material has been augmented by specimens seen by the author while examining the Arizona reptiles and amphibians in the collections of L. M. Klauber, the San Diego Society of Natural History, the University of Southern California, the University of California at Los Angeles, the California Academy of Sciences, Brigham Young University, the University of

*Contribution from the University of Illinois Museum of Natural History and Department of Zoölogy, Urbana.

Utah, University of Kansas, the Museum of Zoology of the University of Michigan, the Chicago Academy of Sciences, and the Chicago Natural History Museum. A series of 99 specimens of *Bufo c. speciosus* from various localities in Oklahoma, in addition to the material gathered by Smith (*loc. cit.*), was also examined from the collection of the University of Oklahoma. In all, 194 specimens of *Bufo c. speciosus* from Oklahoma, Texas, New Mexico, and Tamaulipas; 94 specimens of *B. c. compactilis* from Mexico; 180 specimens of *Bufo w. woodhousii* from Arizona and Utah; and 88 specimens of *B. w. microscaphus* from Arizona, Nevada, and Utah were examined by the author.

In 1867 Cope proposed the name *Bufo microscaphus* for specimens of toads obtained from the upper Colorado River. His proposal received little recognition, however, and in 1889 Cope himself put the name into the synonymy of *Bufo columbiensis (B. b. boreas)*. The name of *Bufo compactilis* gradually came to be applied to Cope's toads, and no further taxonomic efforts were applied to them until Linsdale (1940) reported a breakdown in the characters separating *B. w. woodhousii* and *B. compactilis* (i. e., *microscaphus*). He concluded that the species intergraded and relegated *B. w. woodhousii*, *B. w. fowleri* as well as *B. californicus* to subspecific rank under the older specific name of *compactilis*. This nomenclatural change was not widely accepted, partly because of the improbability that two subspecies would have identical geographic ranges over a large part of the western United States.

B. w. microscaphus is easily separated from the subspecies of *compactilis* in that it lacks an outer cutting metatarsal tubercle (as do all subspecies of *woodhousii*), while two cutting tubercles on each foot are found in all individuals of the two subspecies of *compactilis*. Other differences that serve to differentiate *B. w. microscaphus* from *B. c. speciosus* do not hold for the Mexican *B. c. compactilis*. These differences are discussed in the following paragraphs.

1. The most important of these differences is the presence of two palmar tubercles on *B. w. microscaphus*. The second tubercle is located at the base of the thumb (thenar), and it is always bigger than the subarticular tubercle beneath the distal joint of the thumb. The thenar tubercle is in close approximation to the palmar tubercle (*sens. strict.*), and it occurred in every specimen of *microscaphus* examined. Three small specimens of *B. c. speciosus* from the Gulf Coast of Texas have minute tubercles in the thenar position, but they are no larger than other scattered tubercles on the palm of the hand and are certainly much smaller than the subarticular tubercle of the distal thumb joint. The palmar (as differentiated from thenar) tubercle in *microscaphus* is usually acuminate and much longer than broad, while this tubercle in *B. c. speciosus* is usually rounded and only a little longer, as long as, or less long than broad.

2. The difference in shape of the parotoids and the degree of parotoid divergence between the two groups is striking, but difficult to express. The parotoids are noticeably longer and narrower in *B. w. microscaphus* than in *B. c. speciosus,* and the inner edge of the parotoid is more nearly a straight line in the former, while in the latter it is usually decidedly curved. In *microscaphus,* both parotoids were found to be parallel to the midline in 70 per cent of the specimens and at least one parallel to the midline in 90 per cent of the specimens. Only two per cent of the specimens of *B. c. speciosus* had parotoids parallel to the midline.

3. The parotoids are closer together in *B. w. microscaphus,* and this is another noteworthy point of differentiation from *B. c. speciosus.* The shortest distance between the parotoids in the former was less than, or just equal to, the distance from the extreme posterior border of the upper eyelid to the middle of the nostril in 97 per cent of the specimens examined. In only four did this measurement reach the middle of the nostril. The measurement in *speciosus* was equal to or greater than the above in all cases, although in only 70 per cent was it greater.

4. Small pigmented cornifications, present on nearly all specimens of *B. c. speciosus*, are located on the tubercles of the back. There are one or more cornifications to the tubercle. A few specimens of *Bufo w. microscaphus* (usually intergrades) show similar tubercles, but these usually lack dark pigmentation. The dorsum of the leg may have these warts and should not be included in the examination of the back.

Of the above characters it should be noted that only the shiny, black-bordered, cutting outer metatarsal tubercle, the spinose tubercles, and perhaps the parallel nature of the parotoids may be used to differentiate *B. w. microscaphus* from *B. c. compactilis.* The latter may have decidedly developed thenar tubercles. About 68 per cent of the latter have tubercles of varied sizes, although seldom are these larger than the subarticulars of the distal thumb joint. In addition, of course, there is the presence of a black spotted venter on *B. c. compactilis,* as contrasted to the immaculate venter of *B. w. microscaphus.*

The differences separating *B. w. microscaphus* from the species *compactilis* also serve to differentiate *B. w. woodhousii* from *B. compactilis:* longer parotoids, parallel parotoids, and no cutting outer metatarsal tubercle. Specimens of *Bufo w. woodhousii* have a thenar tubercle on at least one hand in over 90 per cent of the observed cases. In 70 per cent of these, the tubercle was as large as or larger than that of the distal thumb joint. A few large specimens entirely lacked the thenar tubercle. Indistinct or absent cranial crests, lack of a middorsal stripe, less rugose tuberculation as well as a much smaller size, separate *B. w. microscaphus* from *B. w. woodhousii.* Specimens from the Boulder Dam region in Nevada, from the eastern edge of the Kaibab National Forest

in Arizona and from Prescott show intergrading characters These Nevada specimens led Linsdale *(loc cit)* to his earlier mentioned conclusion, his only error being that of allocation

An examination of Figure 1 will demonstrate the expected conclusion that the geographic ranges of *B w microscaphus* and *B w woodhousii* do not overlap, except in intergrading areas The earlier belief that the two forms were sympatric and the fact that *B w microscaphus* had low cranial crests, contrasting to *B w woodhousii* and paralleling *B c speciosus,* have caused long-standing confusion as to the proper names for these toads

Typical *B w woodhousii* probably does not occur in Nevada Specimens on the lower reaches of the Meadow Valley Wash and in the Boulder Dam region are perhaps closer to *B w woodhousii* than to *B w microscaphus,* while the reverse is true in the upper Meadow Valley Wash, but all of them show all stages of intergradation, as do the toads from Indian Spring in the Virgin Mountains, Nevada. Most Utah specimens are closer to *B w microscaphus* but show some intergrading characters with the possible exception of those from Zion Canyon.

It is to be hoped that in the future more extensive collecting of northern and north-central Mohave County, Arizona, will be undertaken A glance at Figure 1 will show how widely separated are the localities from which these amphibians have been taken. This is unfortunately true of most other species of reptiles and amphibians known to inhabit the region

The lack of material is doubly unfortunate, as northwestern Arizona is a region of considerable subspeciation. Two examples of subspeciation in a manner similar to that shown by *B woodhousii* are *Crotalus c cerastes* and *Sauromalus o obesus* on the Mohave desert, and *Crotalus cerastes laterorepens* and *Sauromalus obesus tumidus* to the south and east Neither of the latter two is found on the Colorado Plateau

The range of *Bufo w microscaphus* seems to be dependent upon the peculiar physiography of northwestern Arizona The reasons for the eastern range limits are not all apparent. More than half of Arizona is on the Colorado Plateau, which terminates in a range of mountains running roughly from near the northwest corner of the state to the southeast corner. The lowlands to the south and west of this line are studded with low, short ranges of mountains trending northwest-southeast. This portion of Arizona is part of what is called the basin-and-range physiographical province. It includes a majority of Arizona's desert land, and the lowlands have been described as being of the Lower Sonoran Life Zone The terms Lower Sonoran, Upper Sonoran, Transition and Canadian are useful in a general way as a means of correlating vertical vegetation changes. They will continue to be useful so long as it is remembered that within the altitudinal limits of a given zone

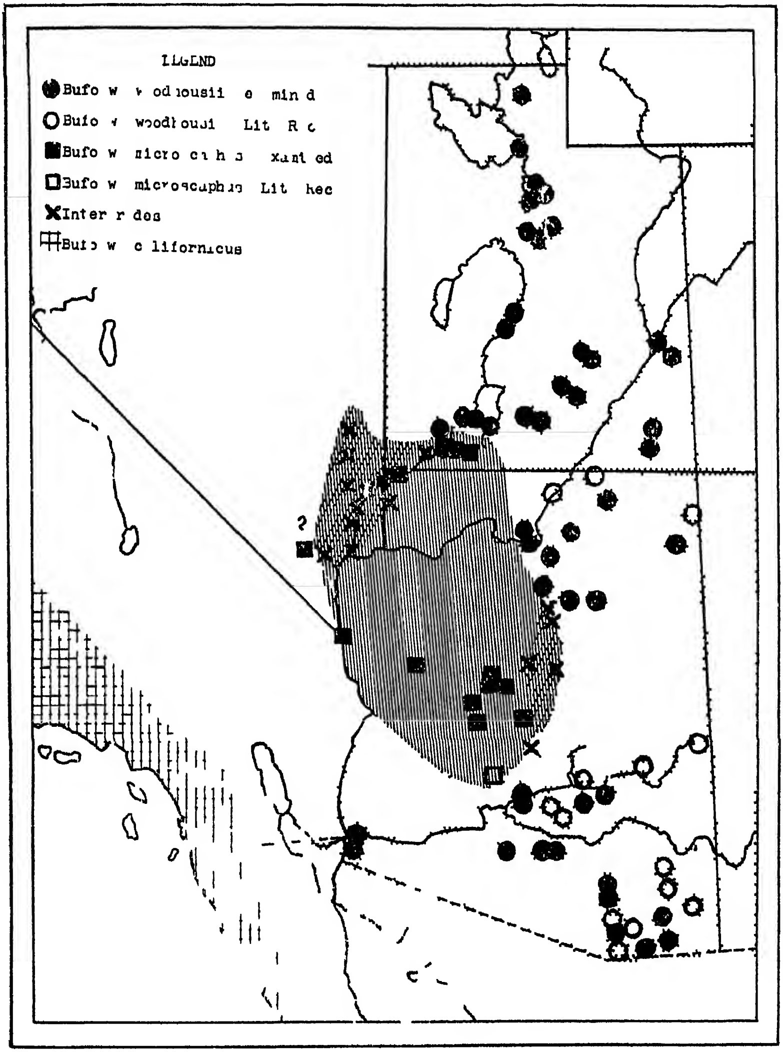

Figure 1. Distribution of southwestern subspecies of *Bufo woodhousii*

specific, and even generic, composition of the flora may vary tremendously from one locality to another.

The Mohave desert region, represented in Arizona by the western half of Mohave County, is markedly different from the Sonoran desert region of the southwest portion of the state. Although creosote bush is common to both, even the tourist notes that the Joshua trees of Mohave County are not to be found farther south. In turn, the Sonoran desert may be divided into the more xeric Colorado desert around Yuma, and a less extreme region, the Arizona desert, occupying the rest of the southwestern portion of the state.

If the associes or association terminology of some ecologists be used, it must be remembered that in Arizona facies (or faciations) of these communities as represented on the plateau are different from those of the highlands off the plateau. Thus the pinyon-juniper association of the Colorado Plateau gives way to evergreen oak-alligator juniper in the mountains south of the plateau.

Bufo w. microscaphus is limited on the west by the Colorado River, although a crossing has been effected in the Lake Mead area. It has spread into the sagebrush subclimax and oak-pinyon-juniper north of the Colorado River and thence into southern Utah, where it intergrades in the vicinity of St. George with *B. w. woodhousii.* The Grand Canyon is apparently not as great a factor in subspeciation as was formerly believed. Whereas the subspecies of *Crotalus viridis* split beautifully around the canyon, others such as *Phrynosoma douglassii hernandesi* cross unchanged, to subspeciate farther north. The tongue-like extensions of intergrading specimens up the drainage of southeastern Nevada may be, as Linsdale *(loc. cit.)* suggests, remnants of a more mesic era. To the east *microscaphus* invades the edge of the Colorado Plateau and may be found in the chaparral and oak-pinyon-juniper associations, but it does not extend into the montane forests around Flagstaff. In the two latter associations the toads are undoubtedly confined to the grasslands around Flagstaff and to the more temperate lowlands, such as may be found in canyons. The same would be true of the oak-pinyon-juniper extending northwest of Flagstaff to the Grand Canyon and beyond the canyon to the north. The toads probably do not flourish on the plateau and give way through a narrow belt of intergradation to *B. w. woodhousii.* What reasons other than competition have combined to prevent the spread of *B. w. microscaphus* into the Arizona desert from Phoenix to Tucson affords interesting speculation. The Arizona desert (as a division of the Sonoran desert subregion) around Wickenburg, where the toads flourish, does seem to be vegetationally different from that to the southeast, and there is a possibility of two different faciations.

Cope (1867) listed the type series of *microscaphus* as a collection made by Dr. Coues on the Colorado River. Cope stated that Coues followed the 35th parallel across Arizona to the Colorado River where the specimens were collected on the river between Forts Mohave and Yuma. He adds two specimens collected by H. B. Mollhausen from "the upper Colorado" (USNM 4106 and 4184) to the cotypical discussion. One of these (4106) is missing. Two specimens have been included in the museum records under the number 4184. One is a normal appearing *B. w. woodhousii* collected by Mollhausen, possibly in Navajo County, Arizona. The other is *B. w. microscaphus,* and as *B. microscaphus,* formed a part of Cope's type description. Why the *B. w. woodhousii* was given the same number is an unanswered question. Cope gave no impression that two toads had been included under the number, and there is little possibility that he would have confused the strongly crested specimen with his *microscaphus.* The specimen was probably unwittingly assigned the same number by a cataloger. Cope's specimen, USNM 4184, is hereby designated the lectotype of *Bufo woodhousii microscaphus* and Fort Mohave, Mohave County, Arizona as the type locality by restriction.

Redescription of type. An adult female 68.5 mm. long. The specimen is rather smooth dorsally, with occasional small tubercles; surface of tibia tuberculate dorsally, each small tubercle with one discolored cornification; venter granular; ventrum of forearms granular; ventrum of metatarsals granular. Dorsum of head and parotoids smooth, entirely lacking tuberculation. Supraorbital and postorbital crests evident, but low-lying, smooth, and inconspicuous; supraorbital crests slightly convergent anteriorly; preorbital, occipital, preparotoid and post-tympanic crests absent. Tympanum half, or less than half, the area of eyelid; longest tympanal diameter in vertical or oblique plane; canthal ridge rounded. Palmar tubercle subacuminate; thenar tubercles well developed and larger than subarticular tubercles of first finger; progress in finger size 2-4-1-3. With the femora and adpressed tibiae at right angles to the body, the heels are separated by a distance of 3 mm. Metatarsal fold moderately developed; inner metatarsal tubercle cutting; outer metatarsal tubercle flat, small and not cutting; toes, with exception of 4th, two-thirds to three-fourths webbed.

Measurement of type in mm. Total length 68.5; interchoanal width 6; internasal width 4.5; nares to eye 5.5; interorbital width 8; width of eyelid 9.4; right parotoid length 13.5; right parotoid width 7; narrowest interparotoid width 12 (posterior margin of eyelid to nares width 15); largest diameter of tympanum 5.5; right foot length 42.5.

Color of type. The ground color is light tan with a profusion of small, irregularly shaped, chocolate brown spots on dorsum of head, legs and body.

Venter unblemished and dull yellow except for a few small black spots on the mandibular surface.

Remarks. The lectotype is unfortunately atypical in presentation of a well blotched skin, which is only rarely seen in the subspecies.

A brief discussion of *Bufo californicus* should be included here. Among his reasons for removing *Bufo californicus* as a subspecies of *Bufo cognatus*, Myers (1930) pointed out that *B. cognatus* has a single palmar tubercle, while *B. californicus* has two; that *cognatus* has an outer cutting metatarsal tubercle, while *californicus* has this tubercle reduced to a small horny point; that crests of *californicus* are less distinct than those of *cognatus.* These features in *B. californicus* are identical to those shown by *B. w. woodhousii.* Linsdale *(loc. cit.)* carried the idea further and stated that, in the absence of consistent morphological differences, the California form should be called *Bufo compactilis californicus.* The writer shares these views, and allocates the toad as *Bufo woodhousii californicus.* There is a certain danger in naming subspecies from discontinuous ranges but at the present time the writer feels that such an action is closest to the truth. *B. w. woodhousii* is apparently narrowly separated from *californicus* in extreme southern California. Considerable study and collecting will be necessary to determine the status and range of *B. w. microscaphus* in the Las Vegas Valley. As Linsdale said *(loc. cit.)*, however, these small, greenish toads with small black dorsal markings can easily be picked out of a mixed collection.

Locality Records. Each of the following lists of locality records has one or more museum numbers attached to it. These numbers represent specimens seen by the writer, except as otherwise indicated. In some cases literature records are included. For each county these are appended to the list of specimens seen and are labeled *Lit. Rec.* In most instances there can be little doubt as to accuracy of allocation. Where any reasonable doubt exists, a question mark follows the citation. Names of counties are printed in *italics.*

Museum abbreviations are as follows:

AMNH	American Museum of Natural History
BYU	Brigham Young University
CA	Chicago Academy of Sciences
CAS	California Academy of Sciences
CNHM	Chicago Natural History Museum
LMK	Private collection of Laurence M. Klauber
MVZ	Museum of Vertebrate Zoology, University of California
SDSNH	San Diego Society of Natural History
UCLA	University of California at Los Angeles
UIMNH	University of Illinois Museum of Natural History
UMMZ	University of Michigan Museum of Zoology
USNM	United States National Museum
UU	University of Utah

An attempt has been made to examine the whole of the Arizona literature for records of both subspecies and, in the case of *B. w. microscaphus,* also that of Utah and Nevada. No attempt was made to compile complete records for Utah except in intergrading regions. Southern Utah records received more attention, as it was considered desirable to determine the range of *B. w. woodhousii* as accurately as possible.

Bufo woodhousii woodhousii Girard

ARIZONA: *Apache*—Ganado, CNHM 51733; E. Branch Apache River, Apache National Forest, UMMZ 84693; Springerville, USNM 52114-6*; Mt. Tunitcha in the Chuska Mts., USNM 60491*. *Cochise*—West of Tombstone on San Pedro River, LMK 4910-1; 10 mi. s.e. Willcox, UMMZ 271023; Ramsey Canyon, Huachuca Mts., SDSNH 14422-7; Carr Canyon, Huachuca Mts., UMMZ 70010-1; North Miller Canyon, UMMZ 75717-20, 72634; Apache, USNM 8505, 8548*. *Coconino*—Tuba City, LMK 6061, SDSNH 12736-7, BYU 803, 804; Leupp, LMK 29254; Lee's Ferry, USNM 5551*. Lit. Rec.: Tanner's Gulch, 3 mi. n. Tuba City (Stejneger, 1890); San Francisco Mt. (Girard, 1854—type loc. and description). *Gila*—Miami, UMMZ 91970; McMillanville, USNM 54566*. Lit. Rec.: Roosevelt Dam (Little, 1940). *Graham*—Fort Grant, USNM 24568-9*; Graham Mts., USNM 51771*. Lit. Rec.: Safford (Slevin, 1928). *Maricopa*—Phoenix, CAS 17719, 35293-4; 5 mi. s. of Phoenix, CA 13704; 13 mi. s. of Phoenix, CA 13294-7; Cave Creek, CAS 17578 (intergrade); Tempe, USNM 17641-2*; Higley, USNM 63062-3*. *Navajo*—Laguna Creek at Tsegi Canyon, UU 1633, 1639; Shonto Canyon, 20 mi. s.w. of Marsh Pass, UU 1643; 4 mi. e. of Winslow, UMMZ 59842; Betatakin Ruin, LMK 34627, 34678-9; Winslow, CNHM 51734. Lit. Rec.: Fort Apache (Cope, 1889); White River Canyon, n. of Fort Apache (Cope, 1889); Dogoszhi Biko above Bat Woman Canyon (Eaton, 1935); Rainbow Lodge (Eaton, 1935). *Pima*—Xavier, LMK 32492; Tucson, SDSNH 1404-19, UCLA 2842; Continental, UCLA 368; Fort Lowell, UCLA 462. *Pinal*—Florence, CA 10170; 8 mi. n.w. of Florence, CA 12932; one-half mi. n. of Florence, CA 10171; 2 mi. n. of Florence, CA 13491, 13495, 4 mi. w. of Florence, CA 12933, 13492-4, 12647, 9552, 1554-9, 10172; Casa Grande, LMK 29337; 9 mi. e. of Casa Grande, LMK 34050; 30 mi. w. of Casa Grande, LMK 32512; Coolidge, SDSNH 14420-1; Arboretum, 4 mi. w. of Superior, CA 13493-4; 8 mi. w. of Superior, CA 9735. *Santa Cruz*—Tubac, SDSNH 14428-30; 7 mi. s. of Tumacacori National Monument, SDSNH 17912, 17915; 5 mi. s. of Tumacacori National Monument, SDSNH 17913; 3½ mi. n. of Nogales, SDSNH 17914; Nogales USNM 2536*. Lit. Rec.: Camp Crittenden, near Patagonia (Yarrow, 1875). *Yavapai*—Camp Verde, USNM 59778 (slight intergrade). *Yuma*—Yuma, LMK 2584-5, 34967, SDSNH 14399-14403, CAS 17718, 33723-7, 33800, UMMZ 64925-6; Somerton, LMK 26828-31, UCLA 625.

NEVADA: (All intergrades). *Clark*—Pahvent, MVZ 43858; Las Vegas, MVZ 8903, 2584; Indian Spring, Virgin Mts., MVZ 19460; Mesquite, LMK 22746-7. Lit. Rec.: 8 mi. n. of Moapa, Bunkerville, 25 mi. above Boulder Dam, 2 mi. s.e. of Overton, Saint Thomas, near mouth of Virgin River (Linsdale, 1940). *Lincoln*—1 mi. s. of Caliente, MVZ 20671, 20673, 20675; 7 mi. s. of Caliente, MVZ 12893, 12895-7; 21 mi. s. of Caliente, MVZ 12891, 12903.

*Not examined by the writer.

UTAH: (All Lit. Rec.): *Washington*—St. George (probably intergrades), Bellevue, Foot of the Pine Valley Mts., Tanner (1931). *San Juan*—Bluff, Blanding, La Sal, Tanner (1931); La Sal Creek, Warner Ranger Station, Tanner and Hayward (1934). *Grand*—Moab, Tanner (1931). *Emery*—Green River City, Tanner (1931). *Utah*—Provo, Fairfield, Utah Lake, Thistle, Spanish Fork, and Payson, Tanner (1931) *Wasatch*—Little Cottonwood Canyon in the Wasatch Mts., Tanner (1931). *Salt Lake*—Fort Douglas and Salt Lake City, Tanner (1931). *Cache*—Logan, Tanner (1931). *Iron*—Cedar City and Parawan, Tanner (1931). *Kane*—Kanab, Tanner (1931). *Garfield*—Penguitch, Tanner (1931); Boulder, Steep Creek, Tropic, Escalate, and junction of Boulder Creek and Escalate River, Tanner (1940). *Sevier*—Richfield and Sabina, Tanner (1931). *Sanpete*—Moroni, Fort Green, Mt. Pleasant, Fairview, and Indianola, Tanner (1931). *Juab*—Nephi, Tanner (1931). *Millard*—Lynndale and Gandy, Tanner (1931).

Bufo woodhousii microscaphus Cope

ARIZONA: *Coconino*—Long Valley, LMK 21023-6 (intergrades); Coconino National Forest, UMMZ 79170 (2), both intergrades; Oak Creek Canyon, 28 mi. s. of Flagstaff, UIMNH 2430, 2432-5, 2461. *Maricopa*—Wickenburg, USNM 73726-8; Marinette, AMNH 53613*. *Mohave*—Wickieup, SDSNH 17309-11; Littlefield, UMMZ 91769 (intergrade); Fort Mohave, USNM 4184—type locality by restriction. *Yavapai*—Prescott, USNM 2287, 22914, 27611, 38060, 41666, 57608, 57610, 57612-3; Fort Whipple, USNM 54551; Yarnell, CA 3147, 3161-70, 3436; 3 mi. n. of Wickenburg, CA 3030-4, 3036; 5 mi. n. of Wickenburg, CA 2878-85, 2912-8, 2931-2, 2942, 2965; 1½ mi. n. of Rock Springs, LMK 33188-90; Senator Mts., CAS 4041; Weaver (Weaverburg), USNM 73726; near mouth of Beaver Creek, Verde River, UMMZ 84785, 84789 (intergrade); Camp Verde, USNM 59776, 59783-4 (all intergrades); between Fort Wingate and FortWhipple, near Prescott, USNM 24577* (?).

UTAH: *Washington*—Zion National Park, MVZ 8908, 12250-2, 12254, 12744, 12746, 12748, 12751; Middletown, MVZ 29838, 29840, 29843. Lit. Rec.: St. George and Bellevue, Tanner (1931); Rockville and Springdale, Wright and Wright (1949).

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*Not examined by the writer.

Key to the Subspecies of *Bufo woodhousii* and *Bufo compactilis*

1a	A cutting, usually glossy black-edged outer metatarsal tubercle	2
1b	Outer metatarsal tubercle not cutting; usually reduced to a round, wart-like production	3
2a (1a)	Venter liberally marked with black spots	*B. c. compactilis.*
2b	Venter immaculate, light	*B. c. speciosus.*
3a (1b)	Cranial crests low or absent; no vertebral light line	4
3b	Cranial crests strongly developed; a contrasting vertebral light line	5
4a (3a)	Parotoids broadly oval and divergent; dorsum covered with dark spots	*B. w. californicus.*
4b	Parotoids elongate and nearly parallel; spotting reduced or absent (except fine black punctations on backs of toads from Vegas Valley, Nevada)	*B. w. microscaphus.*
5a (3b)	Two to five tubercles in each dorsal blotch; postorbital ridge in contact with tympanum; snout-vent length usually less than 80 mm.	*B. w. fowleri.*
5b	Only one or two tubercles in each dorsal blotch; postorbital ridge rarely in contact with tympanum; snout-vent length usually more than 80 mm. in adults.	*B. w. woodhousii.*

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New Species of Nearctic Pselaphid Beetles and a Revision of the Genus *Cedius*

Orlando Park
Northwestern University

Chicago
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Howard K. Gloyd, Director.

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Bulletin of the Chicago Academy of Sciences

New Species of Nearctic Pselaphid Beetles and a Revision of the Genus *Cedius*

Orlando Park
Northwestern University

CONTENTS

The purpose of this report is the description, integration, and discussion of certain new species of Nearctic pselaphid beetles that have accumulated in the author's collection during the past twenty years. An integral part of this work is a revision of the genus *Cedius* that has been under contemplation since 1934.

Pyxidicerini

In the course of field work in the arid Southwest, a series of light traps was operated at night near Superior, Arizona by Dr. Howard K. Gloyd of the Chicago Academy of Sciences. The Pselaphidae were relatively abundant in the samples, and these beetles were sent to the author for study. This material is to be reported upon in detail at a future time, but among the specimens so taken there was a hitherto undescribed species of more than usual taxonomic importance-- so much so that it was felt that it should be discussed here, rather than defer its description to an indefinite date when the Arizona pselaphid fauna could be studied as a whole.

The species alluded to is a member of the tribe Pyxidicerini. This is a small tribe of four genera, only one of which (*Bythinoplectus*) is known from the Western Hemisphere. Previously, *Bythinoplectus* was known only from the Neotropical Region (Park, 1942, p. 37). The Arizona species, then, is in a tribe new to the Nearctic. Furthermore, the Arizona record is another datum that indicates a taxonomic bond between neotropical and nearctic pselaphids by way of the Central American bridge.

***Bythinoplectus gloydi* new species** (Pl. I)

Type Female. Uniform reddish-golden yellow. Pubescence sparse, semi-erect, bristling, hyaline to slightly flavous, moderately long and conspicuous. Integuments strongly polished with sparse punctures. Head 0.27 mm. long x 0.30 mm. wide through eyes; pronotum 0.27 mm. x 0.27 mm.; elytra 0.34 x 0.47 mm.; abdomen 0.47 x 0.47 mm.; total length 1.34 mm.

Head, from a dorsal view, in the shape of an inverted T. Eyes slightly hirsute, small and not prominent from a dorsal view, but from a lateral view, elongate oval in form, and consisting of about thirty-eight small, hemispherical facets. Temporal angles absent as such, the eyes being placed at each end of the base of the inverted T, and the head almost rectilinear from the posterior margin of each eye to the well marked occipital constriction. Each "ocular arm" of the vertex sparsely but coarsely granulate; "vertical arm" of the inverted T with a blackened, granulated boundary, and entirely, deeply concave between lateral borders, the concavity being glabrous. A pair of minute vertexal foveae located on a hypothetical line passing through middle of eyes, and each fovea on a hypothetical line that continues the granulated lateral margin of the "vertical arm" (Pl. I, 1). Face bisected dorsoventrally by a thin, vertical, frontal lamina that unites with a very high, slender, clypeal tubercle, and therefore the face is not excavated between the antennal cavities (as in the males of so many *Batrisodes*), but rather is divided into a huge right and left fossa each of which receives a complicated maxillary palpus. Labrum very transverse with apical margin concave. Mandibles thin, left crossed dorsal to the right. Ventral surface of head simple, gently convex, bearing short, sparse, aciculate setae as in *Euplectus* without a trace of a median, longitudinal carinal or gular suture, but with a deep gular fovea where the genal field meets the cervicum; laterally, the border of the ventral surface is produced into a wide, hyaline margin that forms the floor of the palpal fossa noted above.

The maxillary palpi are large (so that they fill the palpal fossa on each side of the head), complex, and on casual inspection give the appearance of being articulated to the basal segment of the antennae. The reason for this

erroneous point of view is that in the tribe Pyxidicerini the ordinary, relative proportions of the palpal segments are reversed. In the species under discussion the palpi show the same general organization as that of *Bythinoplectus impressifrons* Raffray of Brazil and Dutch Guiana (Park, 1945a, Pl. III, fig. 2,3). In *gloydi*, with the palpi in repose, the first segment is very minute; the second segment is the largest segment of the palpus and shaped like an inverted and flattened Indian club, the pedunculate basal fifth extends dorsally through a narrow slot formed by the base of the mandible above and the limiting carinoid margin of the gena below, and the remaining four-fifths of the segment forms a large, flattened, fusiform club that fills the palpal fossa from eye margin to labral margin; third segment in two parts, a leaf-like basal piece that is almost as wide as the second segment and is articulated on the dorsal surface of the second segment near its apex, but since in repose the second segment has its dorsal face pressed into the palpal fossa and the ventral face exposed, the basal part of the third segment appears to arise from the lower surface of the second segment; the second part of the third segment is in the form of a small, oval, hirsute ball that is obliquely attached at the apex of the basal piece, so that the third segment in total appears as a V with one arm very much shorter than the other; fourth segment in the form of a glabrous, transverse, oval ball that is wider than long and articulated at the apex of the third segment at the junction of the two parts of the latter. This being the case, one is apt to mistake the fourth for the first, and the second for the fourth segment. This complex appendage is illustrated (Pl. I, 2).

Antennae nine-segmented. This readily differentiates the genus as it is the first with nine antennal segments reported from the United States. The antennae articulate at the apical inferior angles of the frontal arm of the head so that the impression is given that this whole arm is an antennal tubercle. First segment obliquely flattened, oblong, almost as wide as ninth segment; second segment about half as wide as first, very slightly longer than wide, and moniliform; third to eighth segments subequal in size, minute, about half the width of second, and submoniliform, with the exception of the eighth which is trapezoidal; club consisting of the distal (ninth) segment, large, about as long as the five preceding segments united, with truncate base, and gradually narrowed apex, its surface bearing sparse, conspicuous granules.

Pronotum slightly narrower than head through the eyes; a deep, glabrous, lateral fovea each side at basal third and a very shallow, median impression that is bisected by a carinoid elevation (reminding one of *Bibloplectus*); disc with a large fovea (reminding one of certain *Euplectus*); surface of pronotum sparsely and distinctly granulate for apical two-thirds, the granulation becoming progressively more dense and conspicuous to the basal margin.

Elytra with prominent subrectangular humeri; each elytron with two relatively large, nude, basal foveae, the sutural at origin of a deep, entire, sutural stria, the discal at origin of a short, streamlined impression that does not extend through more than basal third of elytral length; flank simple.

Mesothoracic wings almost as long as body (1.14 mm. long), strongly iridescent, with the entire margin fringed with alar setae, these latter being graded in length, longest at base and shortest at apex of wing.

Abdomen consisting of five visible tergites and six visible sternites. Lateral margins strongly formed on first three tergites, and narrower but distinct on fourth tergite; a pair of short but strong basal abdominal carinae at the base of each of the first three tergites, these carinae are about one-fourth the segmental length, are separated by about half the total segmental width, and enclose a basal, transverse, heavily pubescent depression; fifth tergite ogival and subvertical in position. First sternite very short, second and third sternites with a short but deep impression along the basal margin, this impression bisected by a low, blackened, carinoid elevation; remaining sternites simple and convex; fourth sternite longer than any of the others.

Prosternum short, transversely tumid, and not bisected by a median carina; mesosternum as long as prosternum, its entire surface densely cribrate; mesocoxae contiguous in confluent coxal cavities; metasternum tumid, not medianly impressed; metacoxae contiguous, with their mesial articulated faces subcylindrical as in euplectines. Legs simple, slender and unarmed. Tarsi typical of Pyxidicerini, apparently one-segmented on casual inspection, but actually consisting of two minute basal segments and a very long distal segment that bears a single tarsal claw.

Described on one specimen, the type, deposited in the author's collection. The unique female was collected in a light trap on the night of July 25, 1948, at the Southwestern Arboretum, 4 miles west of Superior, Pinal County, Arizona, by H. K. Gloyd, for whom this species is named. When males become available, they should be readily recognized, since in this genus, the median vertexal process upon which the antennae are articulated is longitudinally continuous in the female, but is transversely interrupted in the male (Park, 1945a, Pl. III, fig. 2, 3; Park, 1945b, Pl. III, fig. 2, 3).

With the opening remarks concerning this genus in mind, it is of interest to record that of the six previously known species of *Bythinoplectus*, *gloydi* is most closely related to the Mexican *Bythinoplectus denticornis* Raffray known from Tabasco and Morelos. These two species are quickly discriminated in so far as the females are concerned (the males of *gloydi* being unknown): *denticornis* has the antennae relatively much shorter and thicker, the integu-

ments are less shining as a consequence of the more crowded granules, the pubescence is very short, appressed and inconspicuous and the median vertexal process is only slightly impressed medianly· *gloydi* has the antennae relatively elongate and slender, the integuments are strongly shining and the granules larger and sparser, the pubescence is bristling, semi-erect and conspicuous, and the median vertexal process is glabrous and very deeply and entirely excavated.

EUPLECTINI

Trimioplectus auerbachi **new species (Pl. II)**

Type Male. Shining golden yellow. Pubescence composed of short, appressed, flavous setae. Integuments lightly punctulate. Length 1.17 mm. Greatest width 0.45 mm.

Head rounded triangular with prominent eyes occupying about half of the length of the head between occiput and interantennal line of the front, eyes in lateral view deeper than wide, and slightly subreniform. Tempora short, about half as long as an eye, with rounded posterior corners. The top of the head appears to be elevated as a consequence of the eyes being placed far down on the sides of the head. Occiput incised medianly; vertex high, flattened and bearing a pair of nude foveae that are free, not connected by an interfoveal sulcus. A transverse sulcoid depression between frons and vertex. Face simple, with the frontoclypeus steeply declivous to the clypeal bead. Labrum transverse, with slightly concave apical margin. Mandibles prominent, left crossed dorsal to right. In lateral view the circumocular field of the gena has a strong supraocular carina obliquely from center of eye margin dorsally to terminate in a nude fovea beneath the antennal tubercle. This fovea appears to be the homologue of the antennal incisure so well seen in *Batrisodes globosus* (Park, 1947, Pl. I, 1). Ventral surface of head bearing twenty capitate setae. These setae in a basal row of six, a subbasal row of four, a subapical row of four, and an apical row of six; in addition to these capitate setae there is a long, aciculate seta in the subbasal row just internal to the most lateral capitate seta each side, so that this row has six setae, four of which are capitate and two of which are not. It is noteworthy that these capitate setae do not terminate in a sphere as they do in *Melba* (Park, 1942, Pl. IV, 21), but instead, the termination is much longer and more fusiform (Park, 1942, Pl. XII, 1). This is characteristic of the genus. These capitate endings are probably sensory receptors and there is a suggestion that they either transmit or directly secrete a viscous substance since, in the type, most of the capitates are covered with minute particles that have apparently adhered to a sticky surface. In some of the paratypes, these particles are absent, but they

are present in others and, since all of the material was collected in ninty-five per cent ethyl alcohol, there is the further suggestion that the possible secretion contains an alcohol-insoluble component. Maxillary palpi four-segmented, simple; first segment minute; second segment arcuate pedunculate, subcylindrical in basal three-fourths, and swollen in apical one-fourth; third segment subtriangular, with the mesial face more acute, the segment about as wide as the swollen portion of the second; fourth segment almost twice as wide as third, and as long as second and third united with the base rounded-truncate and apex gradually acute to terminate in a small palpal cone set obliquely at apex. Antennae eleven-segmented, simple; from a dorsal view first segment half as long as second, with truncate apex; second elongate oval; third distinctly smaller than second, obconical; fourth to eighth shorter than third, and gradually, slightly increasing in width; club indistinct, composed of the last three segments, typical of the genus, the ninth distinctly larger than eighth, transversely obtrapezoidal, tenth distinctly larger than ninth and transversely obtrapezoidal, but relatively less transverse than the ninth, eleventh slightly wider than tenth and distinctly longer than preceding two united, truncate at base, widest through middle and terminating in a rounded apex.

Pronotum slightly longer than wide, in the ratio of 4:3. Apical and basal margins arcuate; disc simply convex; three large, nude antebasal foveae connected by a transverse sulcus.

Elytra with sloping humeri. Each elytron with two nude basal foveae, the sutural at origin of an entire sutural stria, and the distal at origin of a discal stria that extends almost through the basal half of elytral length; flank simple, with no subhumeral fovea, but with a straight carinoid line that arises in apical third to parallel elytral margin as in *Trimioplectus obsoletus*.

Abdomen with five visible tergites and seven visible sternites. First three tergites with wide lateral margins. First tergite much longer than second, and bearing a minute basal abdominal carina on each side of a transverse, pubescent depression at extreme base of segment in median third of width. First sternite short. Second sternite long, longer than first tergite and medianly very convex. Apical half of second, third, fourth, and basal half of fifth sternites bearing a conspicuous, common concavity on each side (Pl. II, 3). This concavity in sharp contrast to the rather heavily pubescent integument of the venter. Third sternite bears on each side a conspicuous, triangular, laminoid process that extends obliquely over the glabrous concavity just mentioned. Fourth sternite shorter than third; fifth sternite half as long as fourth; sixth sternite as long as fourth, medianly depressed; seventh sternite in the form of a transverse, ovate, penial plate or operculum.

Prosternum simple, not medianly, longitudinally carinate. Intermediate coxal cavities confluent.

Metasternum convex, slightly medianly depressed; posterior coxae subcontiguous, with their mesial faces subconical for articulation with the trochanters, as characteristic of the Euplectini.

Anterior legs with femora swollen and distinctly larger than femora of other legs; ventral faces of anterior femora flattened, this flattened area tending to be scarified toward the anterior face, and bearing two foveoid depressions toward the posterior face. Trochanters of intermediate legs each bearing a short, distinctly triangular tooth at apical three-fourths of ventral face. Tarsi three-segmented, first segment very small; second segment elongate obconical, longer than third; third segment subcylindrical and bearing two tarsal claws, a primary claw that is long, arcuate, and conspicuous, and a secondary claw which is very short, straight, and inconspicuous.

This species is described on four males, the type and three paratypes, in the collection of the author. The type was collected at Glenn, Allegan County, Michigan, August 24, 1948 at 10:00 A. M. C. S. T., from a sugar maple tree hole in a beech-sugar maple forest by Dr. Stanley I. Auerbach after whom this interesting pselaphid is named. A paratype was collected by W. Snow on May 15, 1944, from a tree hole in an American elm at Urbana, Champaign County, Illinois; two paratypes collected by Miss Glenna Corley from a tree hole in a silver maple at Tuscola, Douglas County, Illinois, on June 13 and 29, 1949.

Interestingly enough, the *auerbachi* known so far have been collected only from tree holes. This may be coincidence. On the other hand, *Triniopleclus* is realatively abundant in decaying wood. The genotype, *obsoletus,* described on a male and a female from rotten wood at Cedar Rapids, Iowa (Brendel and Wickham, 1890, p. 51), is known to occur in decaying logs and tree holes. The tree hole is a specialized microhabitat that differs from a decaying log in that the dead substrate of log mold, at least initially, is surrounded by living tree tissue. Evidence accumulating suggests that the pselaphid fauna of tree holes may be quantitatively distinctive (Park, Auerbach, and Corley *). So far, *auerbachi* is not reported from the Chicago area, but it may be expected since it occurs just northeast of this region, in neighboring Allegan County, Michigan, and also about eighty miles south of the southern boundary of the Chicago area, e.g., Urbana, Illinois.

*Park, Orlando, Stanley Auerbach, and Glenna Corley, "The tree hole habitat, with emphasis on the pselaphid beetle fauna," 1950, *in preparation.*

Unfortunately, the female sex is unknown for this species. The male *auerbachi* and male *obsoletus* are easily discriminated on secondary sexual features. The author was able to study the genotype, *obsoletus* Brendel, on October 27, 1948 at the Academy of Natural Sciences of Philadelphia, through the courtesy of A. G. Rehn, Curator of Insects. The holotype of *obsoletus* is a male from Iowa in the Horn collection (H. 9439). This specimen agrees with Brendel's original description in so far as the latter goes. The critical secondary sexual feature of the abdomen was not noted by Brendel. The essential features that allow *obsoletus* and *auerbachi* to be quickly separated are located on the sternites. It will be recalled that in *auerbachi* there is a deep, glabrous concavity occupying the lateral thirds of the third, fourth and base of fifth sternites, and that a conspicuous, triangular, laminoid spine extends from the third sternite over this cavity (Pl. II, 3). In the type of *obsoletus* just referred to, there is no concavity and instead the integuments are uniformly convex, punctulate and pubescent; furthermore, the apparent homologue of the excessive leaf-like spine in *auerbachi* is a minute, oval, apically setose tubercle that is located on each side near the posterior margin of the third sternite (Pl. II, 2). These structural differences appear to be constant between the two species populations. The three male paratypes of *auerbachi* have the lateral cavities and prominent spines of the venter as described for the type; fourteen male *obsoletus* have been examined for these features and are as described for the type of this species in Philadelphia. The differences between the two species of *Trimioplectus* appear to parallel similar differences between the males of *Euplectus*, where in so many cases species criteria are found only in the organization of the sternites of this sex whereas the females can not be separated. Among other differences between these two species are the different sternite proportions as illustrated.

BRACHYGLUTINI

Reichenbachia pluridentata **new species (Pl. III)**

Type Male. Reddish-brown, with maxillary palpi yellowish-brown; pubescence moderately long, semi-erect, golden yellow and conspicuous. Integuments polished and subimpunctate except for pronotal base, where the punctures tend to be coarse and oval, and the elytra, where the punctures are evident and occasionally confused. Length 1.7 mm. Greatest width 0.74 mm.

Top of head, excluding eyes, trapezoidal. Eyes prominent, coarsely faceted; tempora evenly rounded, prominent, as long as eyes; occiput evenly convex and not medianly sulcate. Three foveae present. Each fovea forms a corner of an equilateral triangle; these foveae free, densely pubescent, sub-

equally large, having the diameter of two ocular facets. These foveae consist of a pair of vertexal foveae on a line passing through eye centers, each fovea equidistant between an adjacent eye and the other fovea, and a frontal fovea placed in a depression between the small antennal tubercles. Frontoclypeus simple, gently declivous, with the clypeus terminating in a well-formed basal bead. Mandibles notable, strongly formed, left dorsal to right; inner ramus with three teeth set well behind apex; in addition, each mandible bears a long, strong, apically directed mandibular spine on the external ramus (Pl. III, 2). On casual inspection, these mandibular spines give the impression of gaping jaws and remind one of *Reichenbachia bicuspida* of Guatemala and Mexico (Park, 1945, 1948), but in *bicuspida* the external mandibular processes are broadly triangular teeth, whereas in *pluridentata* these processes are spinoid. Ventral surface of head with the usual median, longitudinal carinoid elevation. Maxillary palpi as for genus. Antennae eleven-segmented, longer than head and pronotum united, essentially unmodified; basal segment longer than wide; second slightly narrower than first, slightly elongate; third obconical, as long as second but narrower; fourth to eighth as wide as third; fourth, fifth and sixth cylindrical with fifth slightly longer; seventh shorter than sixth; eighth segment smallest; club composed of last three segments, the ninth and tenth obtrapezoidal and progressively wider than eighth; eleventh segment largest, with truncate base and obliquely acute apex and nearly as long as preceding three segments united.

Pronotum with evenly convex disc and three antebasal foveae. Lateral foveae densely pubescent and about as large as the vertexal foveae. Median fovea unusual. It will be recalled that in *Reichenbachia* the median pronotal fovea is usually very much smaller than the lateral pronotal foveae. In *pluridentata* this median fovea is exceptionally large, about as large as the lateral foveae but quite shallow and nude. Pronotal base with integument covered sparsely with coarse, elongate punctures that give a substriate appearance to this region; basal margin slightly produced medianly to form an angulate outline.

Elytra with sloping humeri. Each elytron trifoveate; the sutural fovea at origin of a deep, entire sutural stria; intermediate fovea without a stria; humeral fovea at origin of a long discal stria that extends to within one-sixth of apical margin where it curves slightly mesiad; elytral flank simple. The three elytral foveae are all large, nude and penetrate the integument obliquely, so that their basal rims tend to be laminoid and this gives the impression of an interrupted foveal crest, apical of the true basal margin; none of the foveae are elongate.

Abdomen with five visible tergites and five visible sternites. First three tergites with narrow, well-formed lateral margins. First tergite about twice as long as second, bearing a pair of long, divergent basal abdominal carinae. These carinae are thirty-eight per cent as long as the first tergite, and are separated at bases by a transverse distance that exactly equals the maximum strial interspace of the sutural elytral striae. Only the first three tergites are visible from a strictly dorsal view, the last two being subvertical. Venter with the lateral outline evenly concave, as is common for *Reichenbachia* males. First sternite medianly nearly as long as the remaining four segments united; second, third, and fourth sternites short, about half as long as the first sternite; fifth about two-thirds as long as first visible sternite, medianly longitudinally impressed, with an arcuate apical margin.

Prosternum not medianly bisected by a carina. Metasternum gently tumid on either side of a broad, shallow median impression; metacoxae well separated. Legs stout, with anterior and middle femora more inflated than posterior. Intermediate and posterior tibiae slightly arcuate. Intermediate trochanters each bearing a stout, short tooth at base of ventral face, and intermediate tibiae each armed with a long apical spur. Tarsi three-segmented and typical of genus. It should be noted that the single tarsal claw is narrowly and slightly bifid on the anterior tarsi.

The aedeagus of *pluridentata* is typical of *Reichenbachia* in general organization and was figured under this name elsewhere, but not designated as new and not described in detail (Park 1942, Pl. I, 2, 3). The aedeagus is relatively large, measuring 0.6 mm. long x 0.23 mm. wide. The median lobe is elongate oval from a dorsal view, with a basal diaphragm that has its basal margin semicircular and its apical margin trilobate. The lateral lobes are small but very distinct. The entire organ is similar in general to the aedeagus of oxyteline staphylinids as depicted by Blackwelder (1936).

Described on three males, the type and two paratypes in the collection of the author, who collected them in 1933 beneath pieces of moist log mold in Brownfield Woods, Urbana, Champaign County, Illinois, the paratypes on June 15 and 26, the type on August 3.

Reichenbachia pluridentata is a member of Group II of Raffray (1904) and of Group I of Casey (1897) and Bowman (1934). It is allied only to *atlantica* (Brendel), known from Louisiana to Florida along the Gulf Coast. The two species may be separated readily. *R. atlantica* has the occiput triangularly medianly impressed, the median pronotal fovea is very small and punctiform, and the intermediate elytral fovea is oblong. In addition to the prominent mandibular spines, *pluridentata* has the occiput evenly tumid, the median pronotal

fovea almost as large as the lateral foveae, and the intermediate elytral fovea is circular.

In very general organization, *pluridentata* is similar to the males of *rubicunda*, *kansasa*, and *ursina* with respect to the relatively large median pronotal fovea, prominent basal abdominal carinae, and the pubescence. From all of these *pluridentata* males are distinct as a consequence of the prominent mandibular spines, even larger median pronotal fovea, and very divergent and much more approximate basal abdominal carinae. The mandibular spines and toothed intermediate trochanters are probably secondary sex characters restricted to males.

Decarthron rayi **new species** (Pl. IV)

Type Male. Body orange, legs and last antennal segment straw yellow. Pubescence erect, bristling, flavous, and conspicuous by reason of its length. For example, the abdominal pubescence is composed of setae that are 0.16 mm. in length. In other words, many of the setae are one-sixth as long as the body. Integuments shining, subimpunctate, save for the pronotal base (where the integument is confusedly punctate), and the elytra (where the integument bears rather coarse punctures). Length 1 mm.; width 0.5 mm.

Dorsal surface of head, not including eyes, narrowly trapezoidal, the sides being almost parallel; eyes exceptionally large, prominent, and very coarsely faceted, tempora short, one-third as long as eyes (about as long as two ocular facets). Top of head flattened, with simply rounded occiput, and flat vertex, a pair of vertexal foveae on a line almost through anterior third of eyes, these foveae nude, with a diameter of about one and a half ocular facets, and not connected to each other by a sulcus; antennal tubercles small, but prominent, with the front gently depressed between them. Frontoclypeus simple, subvertical. Labrum with apical margin slightly concave. Ventral surface of head with a deep fossa in anterior half, characteristic of the genus. In the present species, this fossa is seen to be open anteriorly where it abuts the submentum, and therefore, from another point of view, the ventral surface of the head has a Y-shaped carina in which the stem of the Y is the undivided gular carina, and the arms of the Y (that form sharp overhanging margins of the fossa) are the right and left gular-genal carinae of comparative anatomy. Maxillary palpi four-segmented; first minute; second arcuate, pedunculate, cylindrical in basal two-thirds and swollen in apical third; third transversely triangular, as wide as apex of second, with an angulate internal face and a convex external face, a long guard seta from the external face; fourth segment longer than second, elongate oval with a distinct palpal cone

at the subacute apex. Antennae ten-segmented, simple; first segment subquadrate; second segment as long and as wide as the first (in dorsal view), suboval; third to seventh subequal in width and gradually decreasing in length; eighth slightly larger than seventh; ninth suddenly larger than eighth, transversely trapezoidal; tenth segment wider than ninth and about two times as long, with subacute apex and truncate base.

Pronotum with disc evenly convex and simple; three antebasal foveae, each fovea perforate, with a diameter of an ocular facet, but appearing much larger as it lies in a circular depression. Pronotum slightly more than half the elytral width.

Elytra with inconspicuous humeri; each elytron with two large basal foveae, each fovea nearly as wide as two ocular facets, nude; sutural fovea at origin of a deep, entire sutural stria; discal fovea at origin of a deep discal stria that extends for four-fifths of elytral length; elytral flank simple. Scutellum triangular and distinct. Mesothoracic wings iridescent, with the usual row of marginal alar setae.

Abdomen with five visible tergites and five visible sternites. First three tergites with narrow margins. First tergite very long, about as long as remainder of abdomen, with a pair of long, arcuate basal carinae. These carinae separated at base by forty-three per cent of total segmental width, separated at apex by fifty-one per cent of total segmental width, and exactly half as long as first segment. Last two tergites subvertical and not visible from above. Venter in two steps from a lateral view: the flattened first sternite nearly twice the length of the rest of the abdomen; second, third, and fourth sternites very short and together form the subvertical wall of the first step; the short fifth sternite forms the second step, and is oblique, medianly glabrous, with an arcuate apical margin. In the type the last tergite and last sternite are alightly retracted and the apex of the aedeagus is exserted. Base of first sternite heavily setose.

Prosternum short, not medianly carinated. Metasternum long, about three-fourths as long as first sternite; rather deeply and broadly sulcate medianly. Metacoxae separated by about half the metasternal length, the metasternum extending between coxae to cover the usually first visible sternite of non-brachyglutine pselaphids. Legs with trochanters not armed. Tarsi as for genus. Mesofemora moderately modified. Each mesofemur flattened at apical five-sixths in the lateromesial plane, this biconcave area divided dorsally by an oblique, carinoid fold, and in addition a very minute denticle set close to the oblique partition at the center of the sloping posterior face (Pl. IV, 2).

Described on one male, the type, in the collection of the author. This interesting species is named after its collector, Eugene Ray, who obtained it from log mold at Eddyville, Pope County, Illinois on May 5, 1934.

This species is allied to *abnorme* (LeConte) and *laurenticum* Casey. It can be quickly separated from both. The lateral pronotal foveae are obsolete in these two but large and obvious in *rayi.* The pubsecence is dark brown in *abnorme*, opaque brownish-black in *laurenticum* and hyaline in *rayi.*

TYCHINI

Tychus daggyi new species (Pl. V)

Type Female. Body yellow orange with legs, antennal club and maxillary palpi yellow. Pubescence long, sparse, semiappressed. In addition to this general body pubescence, each tibia is provided with a single peculiar guard seta (Pl. V, 2). These setae are discussed later. Integuments polished and minutely punctulate. Length 1.5 mm.; greatest width 0.60 mm.

Head elongate suboval. Eyes vestigial, consisting of four facets each. As a consequence of the vestigial eyes, the tempora are very prominent, nearly half as long as head, gradually narrower to the transversely sulcate cervicum. Occiput simple, gently convex. Vertex simple, slightly convex; postfrontal spicules distinct, located halfway between antennal tubercles and vertexal foveae; vertexal foveae small, nude, clearly visible from a dorsal view, and each fovea about as large as a spicule. Antennal tubercles prominent, with the bisecting sulcus not well formed so that the impression is that of a single, undivided tubercle. Face very narrow, reduced to a vertical strip between the large antennal cavities; these cavities mesially separated by the usual hyaline interantennal diaphragm or "window." Clypeus simple. Labrum very transverse, nearly as wide as clypeus, with a truncate apical margin. Mandibles strong, with long rami, the right crossed dorsal to left. Ventral surface of head with a small but distinct, blackened tubercle medianly placed just posterior of the submentum.

Maxillary palpi large and conspicuous; first segment small and subcylindrical; second glabrous, arcuate pedunculate, gradually swollen in apical third; third densely pubescent, in the form of a rounded right triangle, with almost straight external face and angulate internal face, this segment six-sevenths as long as second segment; fourth densely pubescent, with an almost straight external face and a broadly rounded internal face, as wide as maximum width of third but one-fourth longer, with a peduncular articulation to third segment, and a conspicuous, oblique palpal cone. Antennae eleven-segmented; first segment slightly elongate; second elongate oval; third briefly obconical; fourth to eighth as wide as third, transverse moniliform; prominent antennal

club of last three segments, the club as long as segments three to eight inclusive; ninth submoniliforn, twice as long and twice as wide as eighth; tenth submoniliform, slightly wider than ninth; eleventh slightly wider than tenth, longer than preceding two united.

Pronotum rounded-hexagonal; simple, convex disc; a lateral antebasal fovea each side, and a row of five foveae at base, giving the impression of an almost transverse row of seven foveae. The lateral antebasal foveae are deep, oval and pubescent; the five basal foveae are nude and the median of these is larger.

Elytra with rounded humeri; each elytron with two large, deep, nude basal foveae; sutural fovea at origin of an entire sutural stria; discal fovea at origin of a discal stria that extends through basal half; elytral flanks simple. Mesothoracic wings present.

Abdomen with five visible tergites and six visible sternites. Narrow lateral margins on first three tergites. Basal abdominal carinae not present as such, but indicated by a pair of brownish tubercles at base of first segment, separated by half the width of the segment. Venter simple, with the slightly convex outline, from a lateral view, typical of females; second to sixth segments decreasing progressively in length; second as long as the next three united; sixth slightly shorter than fifth and perfectly simple.

Prosternum setose, not bisected by a carina. Metasternum simply tumid. Legs slender, unarmed, and simple with one remarkable exception, as follows.

It is noteworthy that in *daggyi* each tibia bears a coiled guard seta at the basal third of the external face. These setae are conspicuous, about one-third as long as the tibia, and their isolated position and structure tempts one to theorize regarding the ecology of the species. The vestigial eyes in conjunction with the development of what appear to be tactile setae suggest that these beetles lead at least a partially subterranean life, possible in deep leaf mold or soil. Certain of the cavernicolous carabid beetles appear to parallel this pselaphid in that they lack eyes and have prominent guard setae on various portions of the body, and there are similar parallel situations in other genera of pselaphids.

Described on one female, the type, collected by Dr. Tom Daggy, from a berlesed leaf mold sample in Egg Rock Woods, Cabarrus County, North Carolina on February 11, 1949.

This strange species is not placed too satisfactorily but appears to have more in common with *Tychus* than related genera. It has the vertexal foveae of *Tychus* but the ratio in length of the last two maxillary palpal segments is that of *Cylindrarctus.*

The new species is differentiated easily from the described species in both of these genera. In *Tychus, daggyi* and *micropthalmus* are the only two known with vestigial eyes and *micropthalmus* is known only from a male with eight ocular facets and was collected in Cañon City, Colorado (Brendel, 1893). The species known east of the Rocky Mountains have females in which the coiled guard setae are absent and the eyes are well developed. In *Cylindrarctus, daggyi* is comparable only to *longipalpis* since the internal face of the third segment of the maxillary palpi in these two species is strongly and sharply angulated, but *longipalpis* lacks the tibial guard setae and both sexes have prominent eyes. The third segment of the maxillary palpus in *daggyi* is heavily setose, as usual in the genus, and the tips of the setae appear thicker at high magnifications. It can not be decided whether these apical enlargements are capitulations or whether the ends of the setae curl sharply, and the solution of this problem must await more material that can be prepared for examination with the compound microscope. Finally, it will be noted that the length ratio of the second and third tarsal claws varies as between the pairs of legs. That is, the posterior tarsi have the second tarsomere slightly longer than the third, whereas the intermediate and anterior tarsi have the second tarsomere distinctly shorter than the third. The first of the conditions is usually thought of as typical of *Tychus*; the second of these conditions is usually thought of as typical of *Cylindrarctus.*

TYRINI: REVISION OF THE GENUS CEDIUS

The genus *Cedius* was erected by John L. LeConte (1850, p. 74) for two species, *ziegleri* and *spinosus.* LeConte and Horn (1883, p. 87) integrated this genus with other American genera of the family, and Brendel and Wickham (1890, p. 228-230, pl. VI, fig. 10, 11, 11a) redescribed and illustrated LeConte's species. Thomas L. Casey subsequently added a third species, *robustus,* redefined the genus, and gave a key to the three species (1897, p. 626). Later, Charles W. Leng (1920, p. 132) followed Casey's arrangement, and John R. Bowman (1934, p. 132-133) utilized Casey's key in differentiating the three species, and also designated *spinosus* (p. 144) as the genotype of *Cedius.*

The present revision includes the following. (1) A discussion of the comparative morphology of the genus. (2) The comparative morphology of the known species. (3) Secondary structural differences between the sexes. This is necessary since one of the peculiarities of the species is that the females have the spines on the anterior legs even better developed than in the males. This exceptional situation in pselaphids may have contributed to Casey's misunderstanding with regard to sex in *Cedius,* since he applied the

female sternite structure to what was in reality the male (1897, p. 625). (4) Subgenera of *Cedius*. Considerable attention has been paid to the aedeagus and it has been found that the known species are separable into two radically different groups on the basis of the structural plan of the aedeagus and the direction of exsertion of the penial plate. This required the erection of a new subgenus. (5) A key to both sexes of the known species is provided. (6) A new species is described. (7) What appears to be a new sex-linked variety is described.

The present revision has been contemplated for the past sixteen years, and was initiated in August, 1934, when the author collected two specimens of a new species of *Cedius* in northern Indiana. In the course of the investigation the types of the three previously known species have been studied. To this end, the author is indebted to Dr. E. A. Chapin and Dr. R. E. Blackwelder of the U. S. National Museum for permission to study the type of *robustus;* and to Dr. J. C. Bequaert of the Museum of Comparative Zoology for permission to study the types of *ziegleri* and *spinosus.*

COMPARATIVE MORPHOLOGY OF THE GENUS

In this section, generalizations concerning anatomy are understood to refer to both sexes where they are known. This is a genus of relatively large pselaphids, the species ranging from 1.7 mm. to 2.7 mm. in length.

In death the general body tone is a light reddish brown. The pubescence is golden yellow, semiappressed and moderately long and abundant. Integuments polished and subimpunctate except for the elytra and tergites where the punctures are distinct.

Head trapezoidal; eyes prominent in lateral view, subreniform and set at their own depth from the flattened vertex; a distinct infraocular spine extends obliquely from the posterior angle of each eye; tempora very deep and about as long as an eye. Dorsal surface of head with three lightly pubescent foveae. These are a pair of vertexal foveae set on a line through eye centers, and a frontal fovea at base of a longitudinal frontal sinus that separates the antennal tubercles; vertexal foveae are placed near the ocular declivity, so that their orifices are slightly oblique, and not fully visible from above. Laterally, the apical margin of the clypeus extends posteriorly to the anterior eye margin as a carinoid ridge. Genal beard well developed, the setae extending from occiput, posterior eye margin and infraocular spine. Maxillary palpi four-segmented; first segment minute; second strongly arcuate to almost semicircular, gradually tumid from pedunculate base; third very transverse, about twice as wide as long and transversely conical, with a short and convex ex-

ternal face and the internal face formed as a long spinoid process; fourth segment actually almost twice as long as third, but only half as wide. The long concave face of the fourth segment is subparallel to the great width of the third segment, so that on casual inspection, the third and fourth segments appear to have the same length and width. Labrum short, transverse, and just discernibly denticulate at center of apical margin. Mandibles strong, with two to three secondary teeth. Ventral surface of head simple, flattened, with a large gular fovea at base; ventroanterior genal margin erected into a high, laminoid and translucent ridge that partially encloses the maxillary cardo. Antennae eleven-segmented, with an abnormal club in both sexes; first seven segments slightly elongate and subequal in width; eighth with the ventral face apically produced as a conspicuous spinoid process (Pl. VII, 1-5).

Pronotum rounded-hexagonal, widest anterior to middle, basal margin much wider than apical; disc strongly convex, simple; an almost transverse row of three antebasal foveae connected by a deep transverse sulcus.

Elytra with prominent, rounded humeri; each elytron with two large, perforate, almost nude basal foveae; sutural fovea at origin of a deep, entire sutural stria; discal fovea at origin of a discal stria to about apical three-fourths; elytral flank simple, lacking subhumeral fovea.

Mesothoracic wings well developed, their margins fringed with alar setae.

Abdomen with five visible tergites, the lateral margins strongly formed on the first four; first tergite with a pair of basal abdominal carinae that are separated by at least one-third of the segmental width and are at least one-fourth of the segmental length; base of first tergite obliquely depressed, this depression supporting a prominent, blackened, pyramidal tubercle at center of apical margin of depression; fifth tergite sharply set off from fourth by a deep, transverse sinus at base of fifth segment.

Metasternum medianly sulcate; legs relatively thick; tarsi three-segmented, the first segment very short and inconspicuous, second elongate, and third twice as long as second and bearing a pair of strong, equally long, divergent tarsal claws; one of these claws is slightly thinner than the other.

COMPARATIVE MORPHOLOGY OF THE KNOWN SPECIES

Although the two sexes do not differ appreciably in size, there is a differential in average size as between the species populations. For example, the average for *ziegleri* is 2.5 mm. long x 1.0 mm. wide; *cruralis* 1.86 mm. x 0.86 mm.; *spinosus* 1.75 mm. x 0.74 mm. *Cedius robustus,* known only from the male type (USNM Type No. 38760), measures 2.5 mm. in length. These averages were taken with an ocular micrometer for between four to twenty

specimens for each species. They are slightly lower values than usually assigned to the species listed since the measurements in length were across the natural arc of the body rather than measuring each part separately. For example, *ziegleri* measured in the latter way may be as long as 2.8 mm.

There is a differential in ocular facets: both sexes of *ziegleri* have about fifty facets per eye; male *robustus,* about fifty; both sexes of *spinosus,* about forty-six facets; male *cruralis,* about forty-six facets.

Occiput is evenly convex in *ziegleri* and *robustus;* slightly concave medianly in *cruralis;* distinctly sulcoid in *spinosus,* to such an extent that the occiput is divided into a right and left occipital tumidity.

Labrum in *ziegleri, robustus,* and *spinosus* very transverse, being about four times as wide, whereas in *cruralis* the labrum is three times as wide as long.

Maxillary palpi are short and massive in *ziegleri;* third segment in the form of a tumid cone, the height of which (in reality the segmental width) is about three-fifths the length of the fourth segment; fourth segment distinctly oviform. In *spinosus* and *cruralis* the maxillary palpi are relatively slender; third segment in the form of an elongate, acute cone, the height of which almost equals the length of the fourth segment; fourth segment elongate oval, with straight internal face and gently convex external face.

The eighth antennal segment has the apical spine relatively short and thick in *ziegleri* and *robustus,* this spinoid process not extending beyond the apical margin of the ninth antennal segment (Pl. VII, 4, 5). Furthermore, in *ziegleri* the relatively thick antennal club has the eleventh segment only slightly more than twice as wide as long, whereas in *robustus* the antennal club is relatively slender, the eleventh segment being almost three times as long as wide. In *spinosus* and *cruralis* the spine of the eighth antennal segment is relatively long, extending nearly to the apical margin of the tenth antennal segment (Pl. VII, 1, 3).

The spine of the eighth antennal segment is bilaterally symmetrical in *spinosus,* but is bilaterally asymmetrical in *cruralis* (Pl. VII, 2), the spinoid process extending from the lateroventral face and with the mesioventral face tending to be secondarily subtuberculate. Furthermore, this spine is conical and narrows regularly to an acute tip in *spinosus* whereas in *cruralis* this spine is laminoid and apically sharply truncate. Antennal club as illustrated.

In all of the species the pronotal disc is strongly convex but in *cruralis* the disc is gibbous.

The discal elytral stria in *ziegleri* and *cruralis* is much broader and more indistinct than in *spinosus.*

In *ziegleri* the body is widest through the first tergite, but in *spinosus* and *cruralis* the body is widest through the elytra. The basal abdominal

carinae of the first tergite are separated by about one-third of the segmental width, and are slightly more than one-third the segmental length in *ziegleri;* in *spinosus* these carinae are separated by almost one-half the segmental width, and are nearly one-third the segmental length; in *cruralis* these carinae are separated by almost one-half the segmental width, and are relatively short, being about one-fourth the segmental length. In both sexes of *ziegleri* and *spinosus* the fifth tergite is conical, whereas in *cruralis* males this tergite is evenly convex and trapezoidal in outline.

SECONDARY STRUCTURAL DIFFERENCES BETWEEN THE SEXES

The secondary structural differences between the species of *Cedius* have complicated to a certain extent a proper understanding of the problems in the genus. As noted previously, an exceptional situation for pselaphids is involved in that the females, where known, have a sulcoid metasternum, the antennal club and abnormal eighth antennal segment are formed as in males, and the spines of the anterior legs are even larger than in the males.

Sex always can be readily and surely established by an examination of the sternites. Females have six visible sternites, the last of which has the median third of the apical margin produced in a semicircular lobe that is coadapted to a semicircular arcuation of the median third of the apical margin of the fifth tergite (Pl. VII, 11). Males have seven visible sternites, the last of which is in the form of a small circular to transversely oval penial plate that is coadapted to a semicircular arcuation of the center of the apical margin of the sixth sternite and to a similar arcuation of the apical margin of the fifth tergite (Pl. VII, 10). This additional male sternite is fitted so closely, in repose, that good illumination and magnification may be necessary to demonstrate its presence and hence sex discrimination must he done with care. This difficulty may be obviated if specimens are killed in a weak concentration of ether and carbontetrachloride gas since this treatment often causes the males to exsert partially or wholly both penial plate and aedeagus.

Male *ziegleri* have the clypeus strongly and medianly produced in a prominent clypeal tubercle (Pl. VII, 7); female *ziegleri* lack the tubercle and have the clypeus simple and gently declivous and convex (Pl. VII, 8); male *spinosus* have the clypeus simple and gently declivous; female *spinosus* have the clypeus simple and moderately declivous; male *cruralis* have a clypeus that is intermediate between that of male *spinosus* and male *ziegleri* in that the clypeus has a minute tuberculoid swelling. The face as a whole is very strongly excavated in male *ziegleri* (Pl. VII, 7), moderately so in male *cruralis* (Pl. VII, 9), very slightly excavated in both sexes of *spinosus* (Pl. VII, 6), and simply declivous in female *ziegleri* (Pl. VII, 8).

Metasternum is medianly sulcoid in both sexes, but this is broad and shallow in females, and relatively deeper in males. In *cruralis* males the metasternal depression is exceptionally deep, with correspondingly prominent lateral tumidities.

Anterior trochanter always spined in both sexes. There is a single conical spine at center of the trochanter's ventral face in *ziegleri*, *robustus* and *spinosus* (Pl. VIII, 7, 9). The anterior trochanter is unique in *cruralis*, the males having this segment bispinose (Pl. VIII, 12); that is, there is the usual long conical spine and a short, triangular spine between the long spine and the trochantal base.

Mesotrochanter simple, with the ventral face thin and evenly convex in outline in both sexes of *ziegleri*, *spinosus* and male *robustus* (Pl. VIII, 8, 13). In *cruralis* males the mesotrochanter is unique and diagnostic, the ventral face suddenly produced into a conspicuous, laminoid, subquadrate plate (Pl. VIII, 14).

Metatrochanter of both sexes of *ziegleri*, *spinosus* and male *robustus* has a thin, simple ventral face. In *cruralis* males the ventral face of this segment is triangularly produced with an acute apex (Pl. VIII, 15).

The anterior femora are thicker in males than in females, but are spined in both sexes. Furthermore, the femoral spines are larger in females than in males, where both sexes are known. This is exceptional in pselaphids. In male *robustus*, male *cruralis* (Pl. VIII, 12), both sexes of *ziegleri* (Pl. VIII, 7), female *spinosus* (Pl. VIII, 11) the anterior femur is bispinose, a conical spine at the base and a second conical spine at basal third. Male *spinosus* are dimorphic. Typical males have the more distal spine represented by a minute tooth (Pl. VIII, 10); atypical males of what appears to be a new, sex-linked variety have the distal spine wholly absent (Pl. VIII, 16).

SUBGENERA OF CEDIUS

Early in the present study of *Cedius* it became apparent that exact information on the sex of specimens was essential to a proper understanding of the taxonomy of the genus. The aedeagi of *ziegleri*, *spinosus*, and *cruralis* were examined with care and it was found that the genus is divisible into two disparate groups of species of subgeneric rank.

The aedeagus of *Cedius* is large and elongate. This organ in *ziegleri* measures 0.502 x 0.167 mm.; in *spinosus*, 0.361 x 0.124 mm.; and in *cruralis*, 0.335 x 0.134 mm. In these three species (the aedeagus of *robustus* has not been seen), the median lobe has two conspicuous diaphragms on the morphological dorsal surface, a large subcircular basal diaphragm and a smaller sub-

oval apical diaphragm. The apical portion of the latter bears an aperture or fenestration. These two diaphragms lie in the basal two-thirds of the aedeagus; the apical third is a narrow strip of sclerotized cuticle that bears the microscopic apical duct. This duct continues to the apex of the aedeagus. Notably, this apical portion is asymmetrical. This asymmetry takes the form of a sharp turn to either the right or left in the plane of the long axis of the dorsal lobe. This asymmetry is species specific, and can be appreciated by examination of Plate VIII. These illustrations have been adapted from Park (1942, Pl. III, fig. 7, 8, 9).

It will be remembered that the aedeagus in most if not all beetles is rather closely coadapted to the copulatory bursa and associated structures of females within a given population. In *Cedius* it is probable that cross-fertilization between species would be very unlikely indeed. Consequently, where one group of species was found to have aedeageal asymmetry to the right, and another group with aedeageal asymmetry to the left, it is reasonable to assume that such structural divergence represents a fundamental evolutionary cleavage of subgeneric rank.

In support of this aedeageal asymmetry, the seventh sternite or penial plate is exserted at copulation either to the right or to the left in harmony with the direction of the apex of the median lobe. That is, where this apex is angulated to the right the penial plate is exserted to the right, and conversely, where the aedeageal apex is turned to the left, the penial plate is exserted to the left. Furthermore, the exsertion of the penial plate is a movement designed to swing this structure laterodorsally, out of the way of the exserted aedeagus and hence penial plate muscles are involved that are so inserted that they contract either to the right or to the left, as the case may be.

Bowman (1934, p. 144) designated *Cedius spinosus* LeConte as the genotype. Therefore, this species becomes the type of the subgenus *Cedius*, and the latter is characterized by populations the males of which have aedeageal and penial plate asymmetry to the morphological right side. (It must be remembered that when the aedeagus is exserted it lies with its long axis parallel to the long axis of the body, and with its apex directed anteriorly, but with its ventral surface in contact with the ventral surface of the abdomen. Consequently, when the aedeagus is examined from the ventral view, the morphological dorsal surface of the aedeagus is uppermost to the observer. This, in turn, means that if the aedeageal asymmetry is to the morphological left, the apex will appear to be asymmetrical to the observer's right.) With this in mind the genus *Cedius* can be divided into the following two subgenera.

Cedius, sensu strictiore

Species populations the males of which have an aedeagus with the apical diaphragm bearing a minute, pore-like aperture, apex of median lobe strongly arcuate to the morphological right; penial plate exserted to the morphological right (Pl. VIII, 4).

Composition:

1. *Cedius spinosus* LeConte (1850, p. 75)

Published records: South Carolina (LeConte, 1850), Ohio (Dury, 1903, 1908), Indiana (Blatchley, 1910), Pennsylvania (Leng, 1920), New York (Leonard, 1928), Illinois and Indiana (Park, 1935), North Carolina (Brimley, 1942).

Material examined: Type Specimen (MCZ Type No. 6119), South Carolina; Rockville, Pennsylvania (USNM). Author's collection: New York (Long Island); New Jersey (Middlesex); Illinois (Cook); Maryland (Prince Georges); Kentucky (Powell); Tennessee.

a. *spinosus spinosus* LeConte
b. *spinosus obsoletus* new variety

Sinistrocedius, new subgenus

Species populations the males of which have an aedeagus with the apical diaphragm bearing a large aperture that covers as much as one-third of the membrane area, apex of median lobe strongly arcuate to the morphological left; penial plate exserted to the morphological left (Pl. VIII, 1, 2).

Composition:

2. *Cedius ziegleri* LeConte (1850, p. 74)

Published records: Pennsylvania (LeConte, 1850), Pennsylvania (McCook, 1877), Ohio (Dury, 1903, 1908), Indiana (Blatchley, 1910), Pennsylvania, Ohio, Indiana, Iowa and Missouri (Leng, 1920), New York (Leonard, 1928), Mississippi valley north of Missouri (Bowman, 1934).

Material examined: Type Specimen (MCZ Type No. 6118), Pennsylvania; Washington, D. C. (USNM). Author's collection: Massachusetts (Middlesex); New York (Rockland); New Jersey (Essex); Rockville, Pennsylvania; Washington, D. C.

3. *Cedius robustus* Casey (1897, p. 626)

Published records: Washington, D. C. (Casey, 1897; Leng, 1920; Bowman, 1934).

Material examined: Type Specimen (USNM Type No. 38760), District of Columbia.

4. *Cedius cruralis* new species

Material examined: Type and four paratypes. Michigan (Berrien); Indiana (LaPorte); Illinois (Champaign).

KEY TO THE SPECIES OF CEDIUS

Seven sternites visible, the seventh in the form of a small, oval to circular penial plate, MALES, (Pl. VII, 10) 2

Six sternites visible, the sixth with apical margin medianly produced into a rounded lobe, FEMALES, (Pl. VII, 11) 6

2 (1) Spine of eighth antennal segment relatively short, not extending beyond apical margin of ninth antennal segment; clypeus with a conspicuous median tubercle (Pl. VII, 4, 7) 3
Spine of eighth antennal segment relatively long, extending to apical margin of tenth antennal segment; clypeus not having a conspicuous median tubercle (Pl. VII, 1, 3, 6, 9) 4

3 (2) Antennal club relatively slender, the eleventh segment nearly three times as long as wide *robustus* Casey.
Antennal club relatively thick, the eleventh antennal segment only very slightly more than twice as long as wide *zeigleri* LeConte.

4 (2) Mesotrochanter with ventral face suddenly produced into a conspicuous, laminoid, subquadrate plate (Pl. VIII, 14) *cruralis* new species.
Mesotrochanter with ventral face simple 5

5 (4) Profemur with a conical basal spine and a minute denticle at basal third of length (Pl. VIII, 10) *spinosus spinosus* LeConte.
Profemur with a conical basal spine but the denticle at basal third absent, the surface perfectly smooth *spinosus obsoletus* new variety.

6 (1) Spine of eighth antennal segment relatively short, not extending beyond apical margin of ninth segment (Pl. VII, 4) *ziegleri* LeConte.
Spine of eighth antennal segment relatively long, extending to apical margin of tenth antennal segment (Pl. VII, 3) *spinosus* LeConte.

Cedius cruralis new species (Pl. VI, VII, VIII).

Type Male. In life, the general body color is yellow-brown with the elytra having a distinct pinkish cast and maxillary palpi and tarsi yellow; in specimens mounted for fifteen years the elytra lose their pinkish cast and the general body color is yellowish-brown with the brown predominating. This color comparison between living and dead material was made at the same time and at the same magnification and illumination. The antennal club, maxillary palpi, tarsi and distal half of tibiae yellow in mounted specimens. The pubescence in both living and dead specimens is golden yellow, conspicuous, semierect and moderately long. Integuments shining, head and pronotum subimpunctate; elytra, tergites and femora obviously punctate. Length 1.97 mm.; greatest width (through elytra), 0.9 mm.

In addition to the generic anatomy alluded to previously, *cruralis* has the following diagnostic or peculiar features. The eyes have about 46 facets. Occiput only slightly concave medianly. Facial profile intermediate between that of the male *ziegleri* (where it is deeply excavated) and *spinosus* (where it is very slightly impressed). Clypeus intermediate, having a weak transversely tuberculoid swelling that is in sharp contrast to the prominent clypeal tubercle of male *ziegleri* and *robustus* and the perfectly simple clypeus of male *spinosus.* Maxillary palpi relatively slender, with third segment in the form of an elongate acute cone, the height of which (segmental width) almost equals the length of the fourth segment; fourth segment elongate oval, with almost straight internal and gently convex external face. Labrum three times as wide as long. Spine of ventral face of eighth antennal segment relatively long, extending to apical margin of tenth antennal segment, this spine peculiar, laminoid, and apically sharply truncate (Pl. VII, 1). The spine in *spinosus* is as long, but is acute, conical and bilaterally symmetrical. From a ventral view of the antennal club (Pl. VII, 2), the eighth segment of *cruralis* is seen to be asymmetrical, with the spine arising from the lateroventral face and the mesioventral face is also produced into a small tuberculoid process. Pronotal disc much more gibbous than in other species of the genus. Basal abdominal carinae of first tergite relatively short for the genus, convergent, one-fourth the segmental length and separated by one-half the segmental width. Fifth tergite evenly convex and trapezoidal in outline, not conically produced as in the other species. Metasternum deeply impressed in median half, this impression exceptionally wide and deep with rather sharply formed lateral walls that are correspondingly tumid. Each anterior trochanter bispinose, with a long conical spine at center of ventral face and a short, triangular tooth between this spine and base of trochanter; each anterior femur bispinose, with a long conical spine at basal seventh and a second shorter but well-formed

conical spine at basal third (Pl. VIII, 12). This quadrispinose anterior leg is unique in the genus. Middle trochanters each with the ventral face suddenly produced into a prominent, laminoid, subquadrate plate (Pl. VIII, 14) that is unique in the genus. Posterior trochanters each with the ventral face evenly produced into a triangular outline with acute apex. Aedeagus unique, 0.335 mm. long and 0.134 mm. wide, of the *Sinistrocedius* type, but with the apex of the median lobe broadly and bluntly rounded (Pl. VIII, 2, 3) in contrast to the very acute apex of this organ in *ziegleri* (Pl. VIII, 1).

This species was named *cruralis* and the aedeagus illustrated (Park, 1942, pl. III, fig. 9), but not designated as new and not further described at that time.

This new species is described on five males, the type and four paratypes. The type and one paratype were collected by the author in the nest of *Aphaenogaster tennesseensis* Mayr (host ant identified by Dr. M. R. Smith, U. S. Bureau of Entomology) in a decaying sugar maple log in Davis Woods (this forest described by Park and Strohecker, 1936), near Smith, LaPorte County, Indiana on August 18, 1934. One paratype collected by W. S. Snow from a tree hole at Urbana, Champaign County, Illinois. Two paratypes collected by the author's daughter and himself in the nest of *Aphaenogaster tennesseensis* Mayr in a decaying sugar maple stump in Warrens Woods, near Lakeside, Berrien County, Michigan on July 30, 1949. One paratype in the collection of W. S. Snow, type and three paratypes in the author's collection.

The new species is certainly myrmecophilous, and may be an habitual synoekete of *Aphaenogaster.* The related *Cedius ziegleri* is a well known inquiline and has been reported with *Formica rufa* (McCook, 1877), with *Formica integra* and *Formica exsectoides* (Schwarz, 1890), *Formica integra* (Blatchley, 1910) and *Formica exsectoides* (Leonard, 1928) and may be expected with *Formica ulkei* in the Chicago Area. Furthermore, the behavior of *cruralis* and *spinosus* with their hosts (Park and Corley *) suggests a high degree of adjustment. The probability, therefore, is that the tree hole habitat at Urbana may have included *Aphaenogaster* nesting in the tree. In an intensive study of pselaphids living in tree holes (Park, Auerbach and Corley †) no tyrine genera have appeared in the Berlese samples. On the other hand, *Cedius spinosus* has been collected repeatedly in pine logs in Maryland. It may be that species of *Cedius* are facultative synoeketes of ants, as is known for *Batrisodes globosus* (Park, 1947).

*Park, Orlando and Glenna Corley, "Observations on the behavior of pselaphid beetles of the genus *Cedius*," 1950, *in preparation.*

†See footnote, p. 321.

Cedius spinosus obsoletus new variety

In the course of this revision, it became clear that the females of *spinosus* always have the two spines of the anterior femur strongly developed. The males, on the other hand, have the more basal of these two spines consistently smaller than in the female, and the distal spine is either very short or completely absent. At first, it was thought that this differential in the distal spine might represent a variable condition in minuteness. Later, as more material accumulated, it was found that the males are dimorphic, the distal spine either being present or absent. Since complete absence of this spine is restricted to males, it may be that this is a sex-linked character. The LeConte type of *spinosus* is a male (MCZ Type No. 6119) in which the distal of the two femoral spines is present in the typical minute, denticulate form. The condition in which this spine is absent, and at high magnification and illumination the surface of the femora at this point is perfectly smooth and evenly convex, is designated as a new variety, *obsoletus.*

The frequency of the new variety is about one in three. For example, out of fifteen males examined for this feature, ten had the spine in question and five lacked the spine.

It is apparent that *obsoletus* does not represent a new subspecies since these five specimens were distributed over the range of the species, from New York to Illinois. In the case of the Illinois record, both *spinosus spinosus* and *spinosus obsoletus* were taken in the same ant nest.

The records for *obsoletus* in the author's collection are Massapequa, Nassau County, New York; Jamesburg, Middlesex County, New Jersey; Willow Springs, Cook County, Illinois; Palos Park, Cook County, Illinois in the nest of *Aphaenogaster tennesseensis* Mayr, and previously reported (Park, 1935) from the same locality in the nest of *Lasius aphidicola* Walsh.

ABSTRACT

Six hitherto undescribed species of pselaphid beetles are reported for the Nearctic Region. These are *Bythinoplectus gloydi* (Arizona), *Trimioplectus auerbachi* (Michigan and Illinois), *Reichenbachia pluridentata* (Illinois), *Decarthron rayi* (Illinois), *Tychus daggyi* (North Carolina), and *Cedius cruralis* (Indiana, Illinois and Michigan). These new species are illustrated.

A new, apparently sex-linked, variety is described: *Cedius spinosus obsoletus.*

Bythinoplectus gloydi belongs to a tribe hitherto unreported for the Nearctic Region and the zoögeographic implications of this record are briefly indicated.

The genus *Cedius* is revised. This revision includes (1) a discussion of the general morphology of the genus; (2) the comparative morphology of the species; (3) the structural differences between the sexes; (4) the subgenera of the genus, based on the anatomy of the aedeagus and the direction of exsertion of the penial plate, including the erection of a new subgenus, *Sinistrocedius*; (5) a key to the species, based on both sexes where known; (6) description of a new species and a new variety, as noted previously.

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INDEX

Errata:

Page 321, paragragh 5, line 3, read " . . . . relatively abundant . . . . "

Page 325, liue 4, read " . . . . *kansana* . . . . "

Plates I - VIII

These plates have been drawn by Miss Marie Wilson, an experienced illustrator of this family of beetles, and under the constant supervision of the author. The routine was as follows: a typical specimen was selected, and its structural features observed at 70 diameters. In this preliminary conference the range in variation of structure in the population was noted and "key characters" checked. Then the artist drew the beetle by means of a reticule in one of the oculars of the dissecting binocular, transferring the detail seen under each reticule square to a square of a sheet of graph paper. The completed drawing was then gone over by the author, and checked or altered by the artist. The approved drawing was then transferred to drawing paper by means of an illuminated glass-topped drawing table. This drawing was then inked, and the finished plate checked again by the author. Each plate required about twenty hours.

PLATE I

Bythinoplectus [illegible] new species

1 dorsal aspect, female

2 lateral aspect of head female

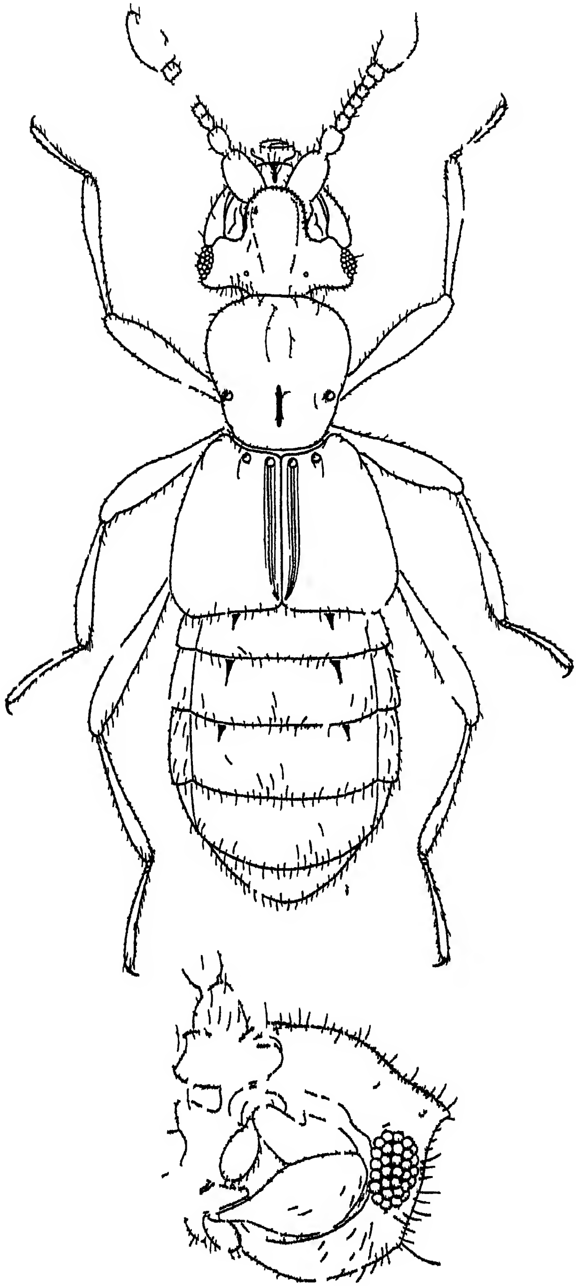


PLATE II

1 *Trimioplectus auerbachi* new species, dorsal aspect
2 Venter of *T. obsoletus* Brendel, male (lower right)
3 Venter of *T. auerbachi* new species, male (lower left)

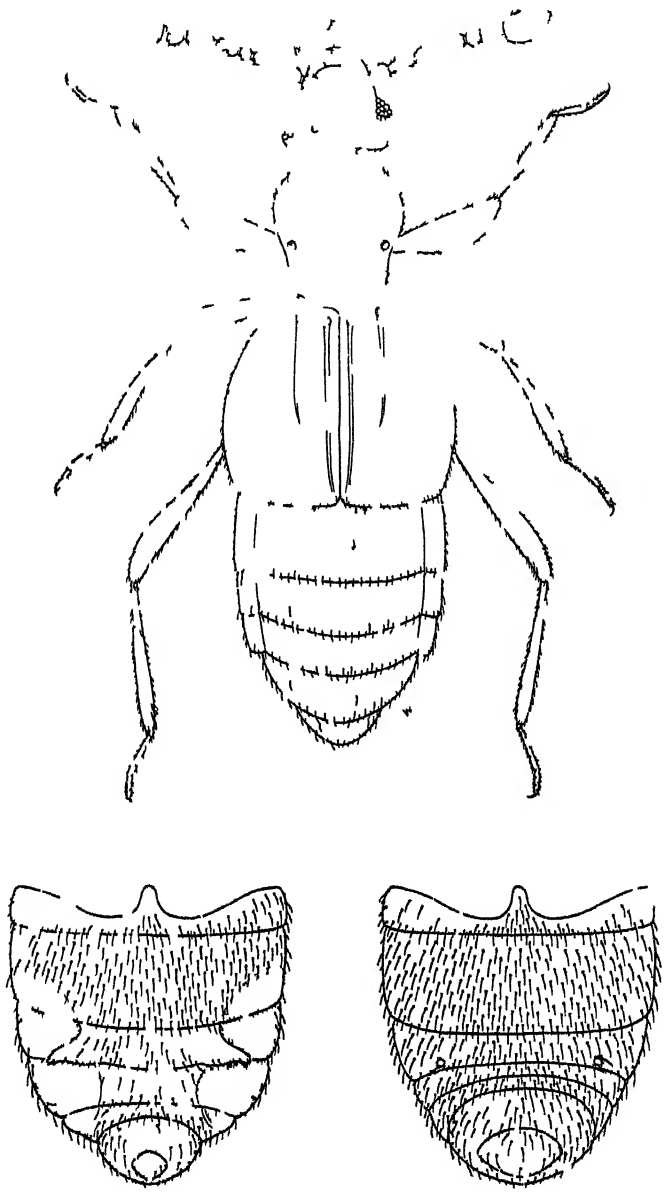


PLATE III

Reichenbachia pluridentata new species

1. dorsal aspect, male
2. detail of mandibles
3. bifid claw of anterior tarsus (upper left)

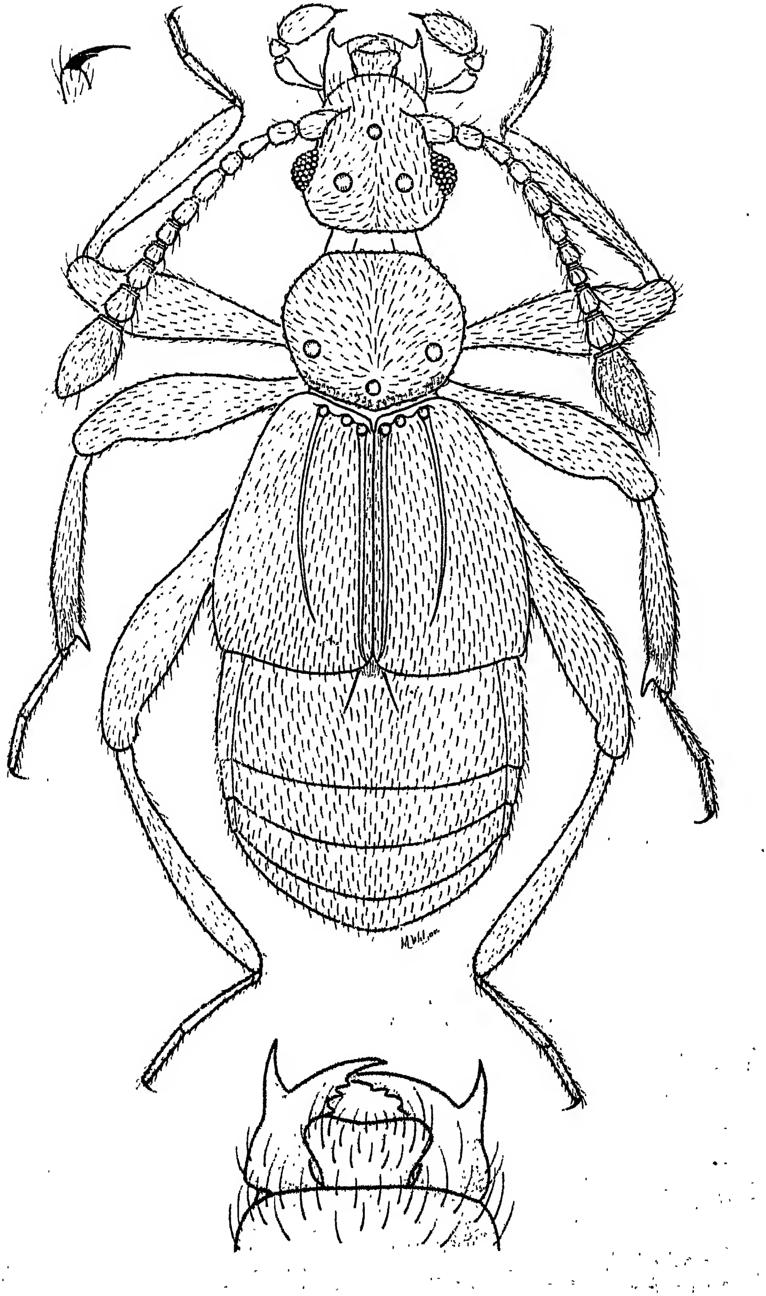
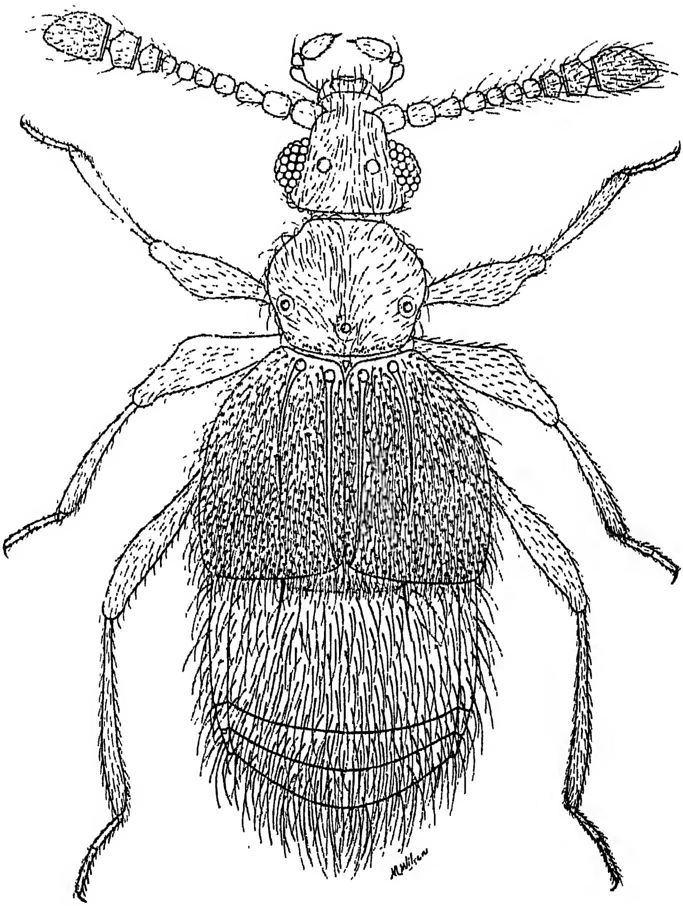


PLATE IV

Decarthron rayi new species

1. dorsal aspect, male
2. mesothoracic femur, male



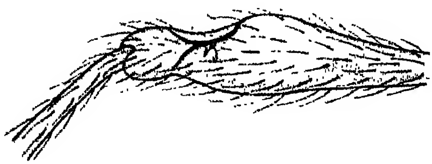


PLATE V

Tychus daggyi new species

1 dorsal aspect, female
2 stereogram of a part of right metathoracic tibia, from a slide mount at 400 diameters magnification

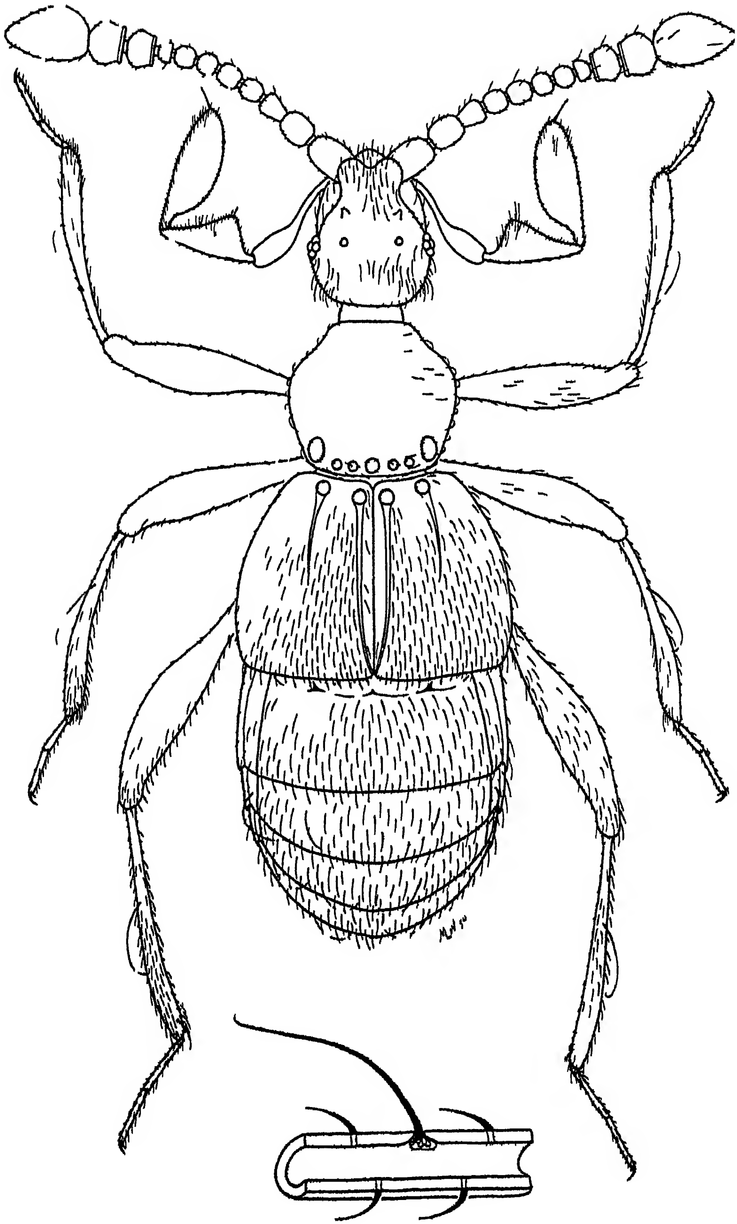


PLATE VI

Cadiu cruralis new species, male, dorsal aspect

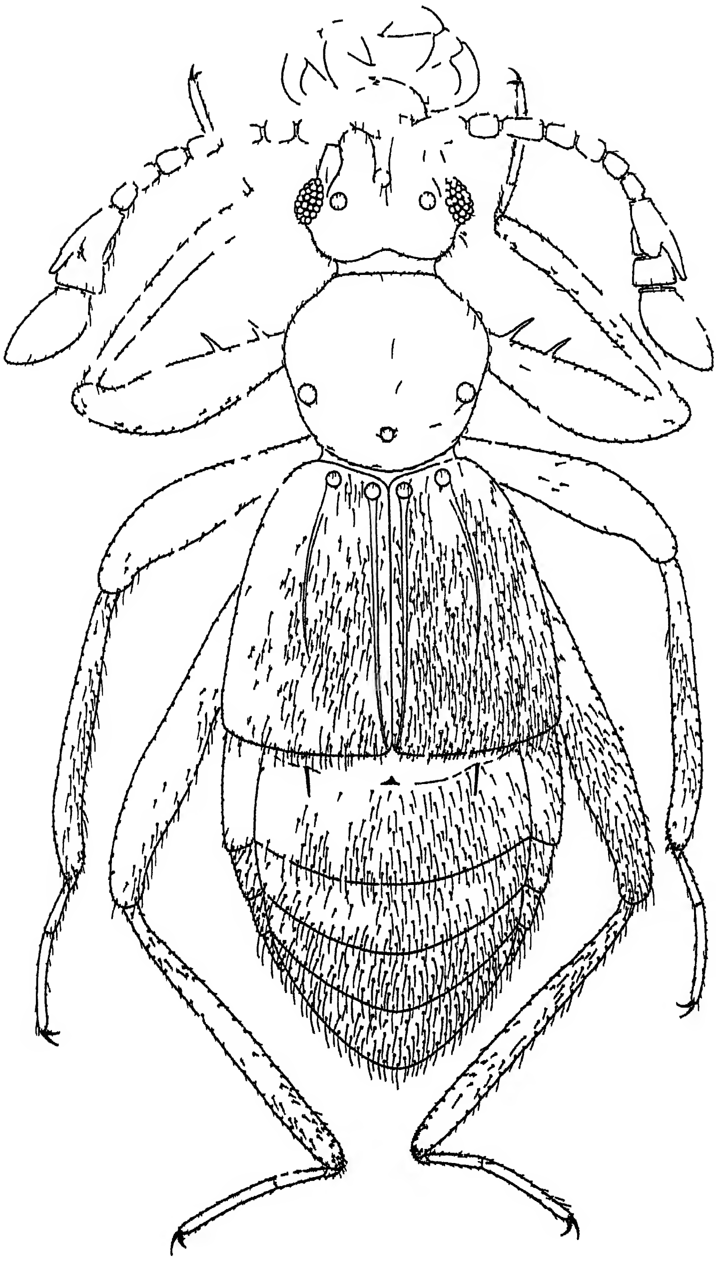
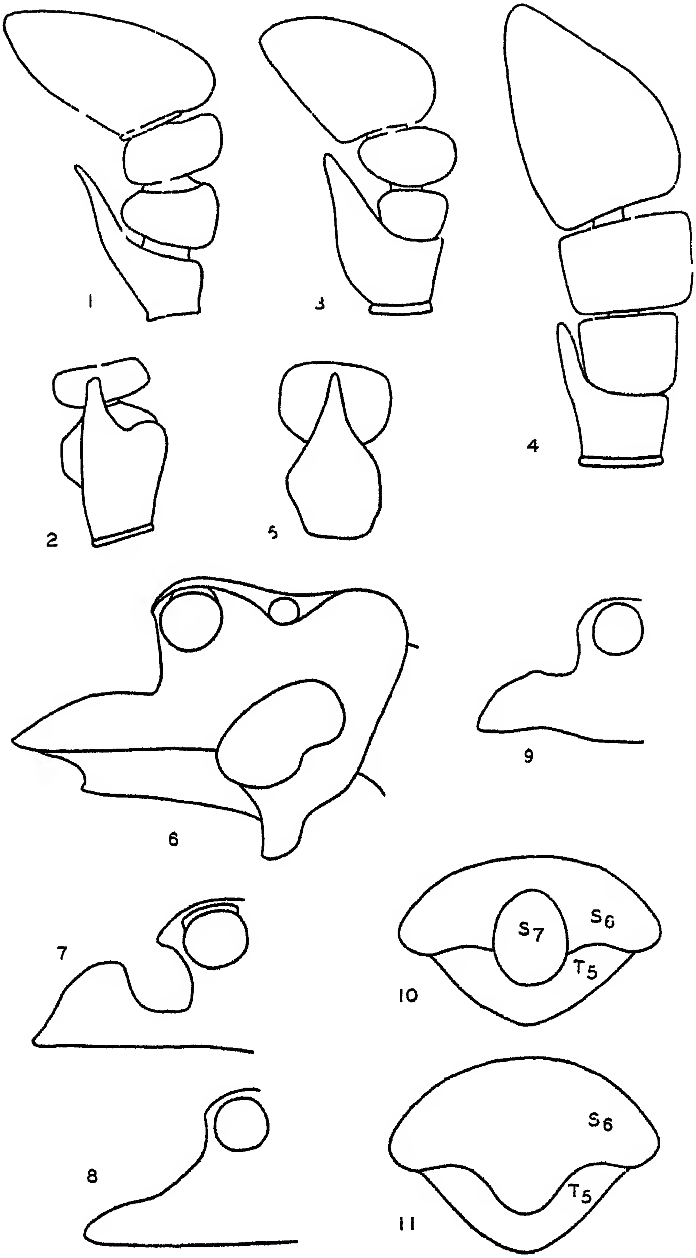


PLATE VII

Cedius

1 antennal club of *[illegible]*, lateral aspect
2 eighth, ninth and tenth antennal segments of *[illegible]*, ventral view
3 antennal club of *spinosus*, lateral view
4 antennal club of *ziegleri*, lateral view
5 eighth and ninth antennal segments of *ziegleri*, ventral view
6 lateral aspect of head of *spinosus*, both sexes
7 lateral aspect of head of *ziegleri*, male
8 lateral aspect of head of *ziegleri*, female
9 lateral aspect of head of *[illegible]*, male
10 terminal tergite and sternites of male *spinosus*
11 terminal tergite and sternite of female *spinosus*


1
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T5
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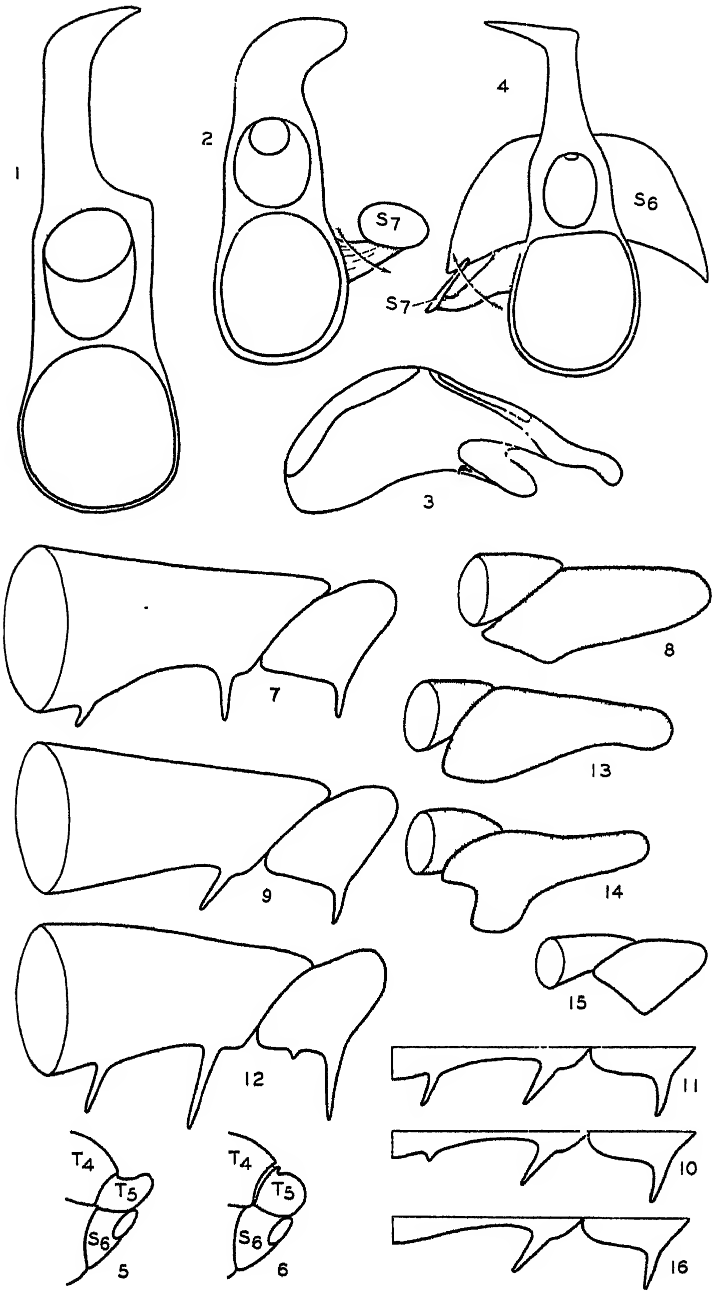
S6
T5
11

Plate VIII

Cedius

1. aedeagus, dorsal view, *ziegleri* (after Park, 1942)
2. aedeagus, dorsal view, *cruralis* (after Park, 1942)
3. aedeagus, lateral view, *cruralis*
4. aedeagus, dorsal view, *spinosus* (after Park, 1942)
5. abdominal apex, *spinosus*, male
6. abdominal apex, *cruralis*, male
7. prothoracic trochanter and femur, lateral view, *ziegleri*, both sexes
8. mesothoracic trochanter, *ziegleri*, both sexes
9. prothoracic trochanter and femur, lateral view, *spinosus obsoletus*, male
10. prothoracic trochanter-femoral outline, *spinosus spinosus*, male
11. prothoracic trochanter-femoral outline, *spinosus*, female
12. prothoracic trochanter and femur, lateral view, *cruralis*, male
13. mesothoracic trochanter, *spinosus*, both sexes
14. mesothoracic trochanter, *cruralis*, male
15. metathoracic trochanter, *cruralis*, male
16. prothoracic trochanter-femoral outline, *spinosus obsoletus*, male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NOTE: Numbers 3 and 16 of this volume are indexed separately and only authors, titles, subjects and *new names* appearing in these articles are included in the following index The tabular lists of Texan amphibians and reptiles in Number 1 are indexed to major categories and the checklists of pselaphid beetles in Numbers 4 and 8 are indexed to genera only. New generic and specific names in all 16 numbers are printed in bold type.